

ISSUE #1 SPRING 2018

ACCELERATE

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C H I N A

BLUE-SKY THINKING



Alan Lin,
METRO China

p. 22

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Marc Chasserot
Founder

THE TIME IS NOW

— Founder's Note by Marc Chasserot

For more than a decade, shecco has had the opportunity to interact with, observe, and learn from China's HVAC&R industry. China has long been recognised as the world's largest and most important market for HVAC&R technology. Today, developments in China are happening at a pace faster than ever before.

I therefore believe that China is no longer simply a manufacturing base; it is an emerging hub for technology innovation that will have a huge influence on the global market.

This is why shecco is organising the first ATMOSphere conference in China this Spring, bringing some of the world's and China's experts to share their knowledge on natural refrigerant technology and market. Next to this important milestone, we are proud to present the first edition of *Accelerate China*, showcasing the best of natural refrigerant-based technology across all sectors of China's HVAC&R industry.

Accelerate China will cover applications of CO₂, ammonia, hydrocarbons, water and air-based technologies. We

will focus in particular on the end user experience. We will feature interviews, opinions and analysis by HVAC&R industry leaders and experts. We will highlight the most relevant and up-to-date market, technology and policy trends. We will share best practices with a focus on the ever-growing need for training and servicing. And of course, we will also report about the challenges of applying natural refrigerant-based technologies.

Most importantly, we will shine a light on the people who are leading this transition to natural refrigerant technology in China.

Recognising the importance of bringing this message to the wider local industry, we have decided to publish our special first edition in both English and Chinese (Mandarin).

The world now has its eyes set on China's fast-growing HVAC&R industry. With *Accelerate China*, we hope to contribute to make this growth sustainable.

Enjoy our first issue and feel free to send me your comments at marc.chasserot@shecco.com.

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传真: (+8621) 3777 5970
手机: +86 138-1687-9731 联系信息: 张孟龙先生
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F2, Building 15, No 1881, LaiYin Road, Songjiang District,
Shanghai, China / Post Code: 201615
Tel: (+8621) 3777 5972 Fax: (+8621) 3777 5970
Mobile: +86 138-1687-9731 Contact person: David Zhang
Email add: dz@futechina.com.cn
Web-Site: www.futechina.com.cn

New horizons, new opportunities

— Editor's Note by Andrew Williams

Welcome to the first edition of *Accelerate China*, the newest member of the *Accelerate* magazine family! As we gear up for our first ever ATMOSphere conference in China, to be held in Beijing alongside China Refrigeration next month, China's economy continues to grow at an impressive pace.

With growth comes opportunity – for businesses to thrive, and for consumers to enjoy more disposable income. Demand for air conditioning, in particular, is expected to soar as the country's burgeoning middle classes seize the opportunity to install their own systems at home.

With the Kigali Amendment to the Montreal Protocol requiring countries around the world to reduce the climate impact of HVAC&R (p. 16), switching directly from HCFCs to natural refrigerants offers China a unique opportunity to stimulate new investment while putting its economy on a more sustainable development path.

Our cover story for this first edition looks at Chinese retail's first CO₂ transcritical system, in a METRO wholesale store in Beijing (p. 22).

With other local end users such as Hong Fu Supermarkets also opting for CO₂ (p. 70), leading domestic contractors and overseas suppliers are calling for more training and more local availability of CO₂ components for a food retail market that is ripe for growth (p. 62).

The China Chain Store & Franchise Association, for its part, is confident that natural refrigerants will play a central role in moving Chinese retail into a bold new era (p. 56).

Beyond China's borders, international companies Nestlé (p. 32) and Aldi US (p. 42) offer inspiration for others looking to chart a natural refrigerants course.

Indeed, as major end users in Europe and the USA continue to adopt natural refrigerants, so too will Chinese companies continue to manufacture natural refrigerant-based HVAC&R technology for export. In 2018, technology integration and increased competition between natural refrigerants will help grow the market worldwide (p. 50).

Policy developments are poised to help grow the market for natural refrigerants too. Amid mounting legislative pressure on refrigerant gases with high global warming potential around the world, the market for flammable alternatives such as hydrocarbons is poised to grow (p. 18).

From global beverage giants to European supermarkets, a growing number of companies worldwide are in fact already taking advantage of the efficiency and versatility of hydrocarbons (p. 46).

China itself, meanwhile, has already come to grips with hydrocarbons in domestic refrigeration. The light commercial market is next (p. 58).

With these and other stories in store for you in this first edition of *Accelerate China*, I trust you will enjoy reading it. See you in Beijing in April!



ABOVE
Accelerate China team at METRO
wholesale store in Beijing



Andrew Williams
Editor

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中国连锁经营协会
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About *Accelerate China*

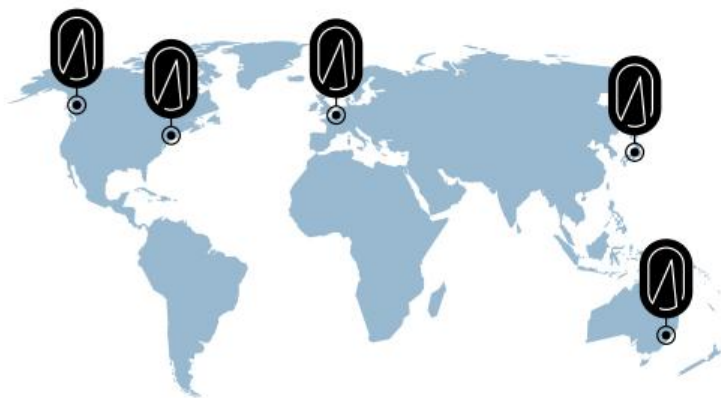
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The *Accelerate* family of magazines includes editions in Europe, America, Japan, and Australia & New Zealand.

Printed copies are available to pick up at leading HVAC&R tradeshows and are posted to key end users and industry professionals.

<http://accelerate.shecco.com/>

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/ Ad sales

Jan Dusek
jan.dusek@shecco.com
+81 80 3558 6464

GOT A STORY IDEA?

/ Editor

Andrew Williams
andrew.williams@shecco.com
+32 (0)2 899 25 63

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Founder

Marc Chasserot
marc.chasserot@shecco.com
@marcchasserot

Publisher

Jan Dusek
jan.dusek@shecco.com

Editor

Andrew Williams
andrew.williams@shecco.com
@a_williams1982

Reporter

Devin Yoshimoto
devin.yoshimoto@shecco.com

Contributing Writers

Pilar Aleu
Marie Battesti
Michael Garry
Elise Herron
Eda Isaksson
Charlotte McLaughlin
Rena Okabe
Álvaro de Oña

Advertising Manager

Jan Dusek
jan.dusek@shecco.com

Events Coordinator

Yingwei Tao

Art Director

Anna Salhofer

Graphic Designers

Charlotte Georis
Juliana Gómez

Photographers

Peter Barnes
Ben Cleeton
Anna Salhofer
Yingwei Tao

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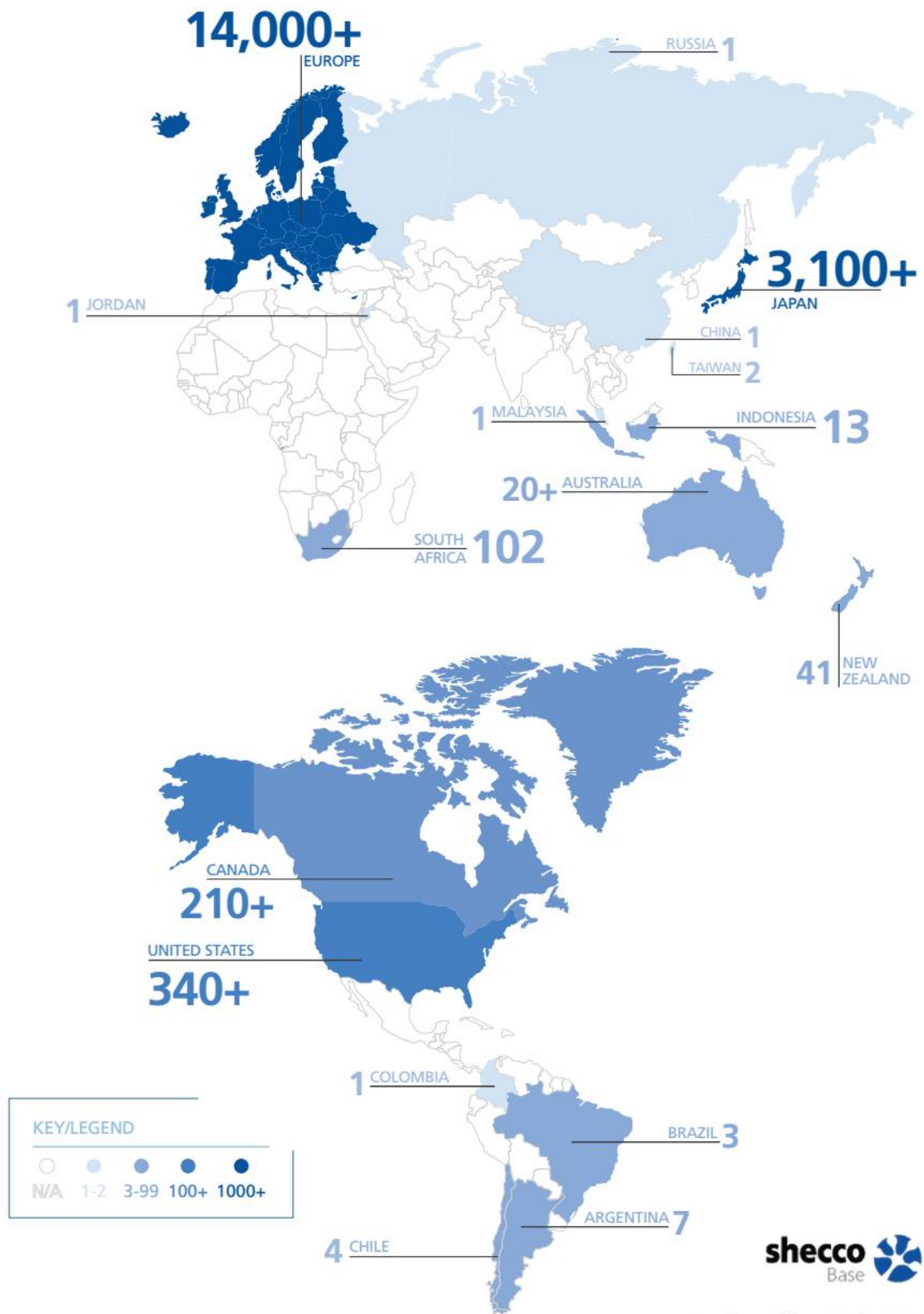
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Dispatch from Montreal

Last November the Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer gathered in Montreal, Canada to accelerate the transition to ozone- and climate-friendly refrigerants. *Accelerate China* reports from their 29th Meeting.

– By Marie Battesti

Just a few days ahead of the 29th Meeting of the Parties to the Montreal Protocol (MOP29) in Montreal, Canada – held on 20-24 November 2017 – the Kigali Amendment on phasing down HFCs was ratified by Sweden and Trinidad & Tobago, bringing the deal over the required 20-party ratification threshold in order to enter into force on the earliest possible date: 1 January 2019.

The Kigali Amendment is a landmark international agreement to phase down the production and use of HFCs. It requires developed countries to take the lead on phasing down these potent greenhouse gases, starting with a 10% reduction in 2019 and delivering an 85% cut in 2036 (compared to the 2011-2013 baseline).

The primary goal of MOP29 was to make progress on adopting concrete implementing measures to ensure all signatories can achieve the Kigali Amendment objectives.

Energy efficiency

The topic of integrating energy efficiency into the requirements of the Kigali Amendment is relatively new to the MOP agenda. According to experts at the meeting, improving energy efficiency while phasing down HFCs could at least double the climate change mitigation benefits of the HFC phasedown.

Uncertain future for synthetic refrigerants

HFOs came up as a topic of some concern in Montreal. Philip Owen from the European Commission, the executive arm of the European Union, cited the Ozone Research Managers' conclusion that the formation of toxic TFA (trifluoroacetic acid), as well as tropospheric ozone, results from the degradation of HFOs. This "is a concern which requires further research and evaluation," he said.

Questions have been raised about HFOs' impact on the environment, particularly their decomposition in the atmosphere into TFA, a long-lasting substance that descends to the earth as a form of 'acid rain' and accumulates in freshwater bodies.

TFA's long-term toxicity has been the subject of ongoing scientific study. One 2014 study in *Chemosphere* – 'A 17-fold increase of trifluoroacetic acid in landscape waters of Beijing, China during the last decade' – recommended that "measures are needed to control the increase of TFA in China".

In other activity at MOP29, Norway and Switzerland reintroduced a draft decision to adopt a precautionary approach to the development and promotion of low-GWP, one-component HFCs that are not listed as controlled substances by the Kigali HFC phasedown scheme and have a GWP greater than 53 (the lowest GWP of covered HFCs).

And in a final decision, the Parties at MOP29 requested the Protocol Assessment Panels to provide a report evaluating the consumption and production of these low-GWP HFCs in time for the MOP in 2023 and every four years thereafter.

Countries requested the Technology and Economic Assessment Panel (TEAP), an advisory body to the Montreal Protocol Parties, to assess technology options, requirements and related costs to maintain or enhance energy efficiency while phasing down HFCs under the Kigali Amendment. TEAP will make its recommendations in a report to be presented to the next Meeting of the Parties, to be held on 5-9 November 2018 in Quito, Ecuador.

Replenishing the Multilateral Fund

One key decision was to determine how much money would be allocated to support developing countries in achieving the HCFC phaseout and the HFC phasedown required under the Montreal Protocol and the Kigali Amendment to the Montreal Protocol – i.e. the replenishment of the Multilateral Fund (MLF).

Delegates' most pressing task was to successfully conclude the MLF replenishment negotiations for the triennium 2018-2020. The MLF replenishment is crucial for developing (Article 5) countries, as the fund finances activities to help meet their compliance obligations to phase out ozone-depleting substances.

After long negotiations, the Parties adopted a budget for the MLF for the triennium 2018-2020 of USD 540,000,000 (CNY 3,490,428,129).

Smarter standards to achieve Kigali HFC phasedown

The need to update safety standards impeding the uptake of flammable refrigerants such as hydrocarbons was addressed by a number of countries throughout the week.

The Parties decided to hold regular consultations with relevant standardisation organisations, with a view to providing an overview of the relevant safety standards governing flammable low-GWP refrigerants.

The overview will include information on the scope of standards (i.e. activities, appliances or products covered), content (i.e. safety-relevant technical aspects addressed), and information on the review process. ■ MB



Hydrocarbon safety standards high on global agenda

Amid mounting legislative pressure on refrigerant gases with high global warming potential around the world, it is clear that the market for flammable alternatives such as hydrocarbons is poised to grow.

– By Klára Skačánová

Hydrocarbons such as propane and isobutane stand to benefit from the global HFC phasedown put in place by the Kigali Amendment to the Montreal Protocol due to their low climate impact and extraordinary energy performance. Yet their use has thus far been limited by restrictions anchored in industry standards.

Historically the standard-making process was primarily focused on chemical refrigerants. Specific requirements for natural flammable refrigerants were not prioritised. This can be put down to a lack of awareness and knowledge at the time of drafting the standards, and was exacerbated by the commercial interests of chemical refrigerant manufacturers.

The main standards barrier to hydrocarbons uptake relates to the maximum allowed quantity of flammable refrigerant in refrigeration, heat pump and air-conditioning (AC) equipment. The cooling capacity of natural, flammable refrigerants depends on refrigerant quantity, which is often strictly limited by industry standards.

Several of the assumptions in current international standards are not based on scientific measurements. For example, IEC 60335-2-40 for residential AC and heat pumps assumes a

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constant leak rate and the leakage of the entire charge in four minutes, and that occupied spaces are gas tight – “none of which is based on reality,” according to consultant Dr. Daniel Colbourne, who sits on the UNEP RAC&HP Technical Options Committee under the Montreal Protocol.

Current standards fail to take into account the multitude of available risk mitigation measures, such as improved system tightness, systems with integral airflow, or housing design. These would allow for higher refrigerant charge limits while maintaining at least the same level of safety.

Several international and regional standards are now undergoing revisions to facilitate the use of higher charges of flammable refrigerant. These revisions are critical to the success of the Kigali Amendment to the Montreal Protocol, which foresees a global phasedown of HFCs starting in 2019 in developed countries and in 2024 in developing countries.

In the Montreal Protocol meetings, China has been vocal in stressing the urgent need to revise outdated international standards without further delay. On its initiative, the Parties decided at their latest meeting in November 2017 to hold regular consultations with relevant standardisation organisations, with a view to providing an overview of the relevant safety standards regarding flammable low-GWP refrigerants.

Commercial refrigeration on track for increased charge limits

The revision of charge size limits for hydrocarbons in commercial refrigeration (IEC 60335-2-89 standard) is underway. In October 2017, International Electrotechnical Commission (IEC) subcommittee SC61C decided to advance the draft amendment of the standard, prepared by Working Group 4 (WG4), to the next stage in the process (CDV; Committee Draft for Vote).

The final version of the draft amendment proposes to calculate the maximum allowable charge limit as 13 times the low flammability limit (LFL). The charge limit increase will cover every safety class of flammable refrigerant, but with

different limits. For propane, the charge limit would increase to 500g from the current 150g. To ensure safety, the draft amendment will require a minimum room area in which systems can be placed. Systems must pass a leakage test demonstrating the relative absence of flammable concentrations around the system, besides other construction requirements.

The CDV is being circulated for votes and comments to all national committees within the IEC at the beginning of 2018. A vote on the CDV is expected later in 2018. During this period it will be critical for industry to support the draft amendment in order to avoid a lengthy revision of the proposed draft and the delayed adoption of the amended standard. Provided that more than two-thirds of the committee members vote in favour, the draft will go to the final vote phase (FDIS) by the end of 2018 following the SC61C committee meeting in Busan, South Korea in October 2018.

A new version of the IEC standard is expected at the beginning of 2019.

Manufacturers and end users are eagerly expecting the adoption of revised standards, as this will open up opportunities for hydrocarbons globally. Allowing higher hydrocarbon charges in commercial refrigeration will make energy-efficient technology more accessible to end users as the use of multiple refrigeration circuits will no longer be necessary in these products.

Review of other standards progressing slowly

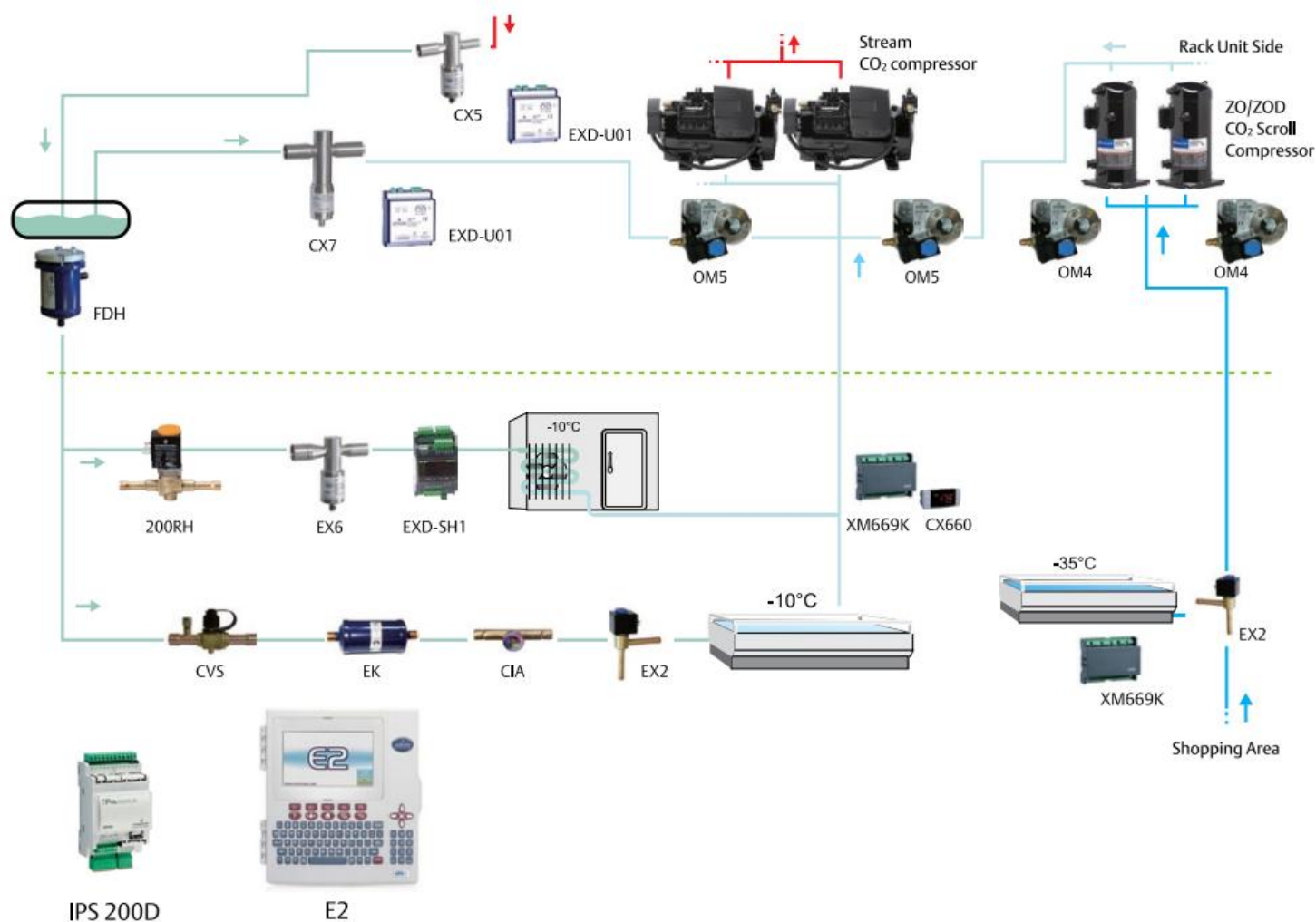
As for IEC 60335-2-40, a proposal to address the charge size of A3 and mitigation measures is currently at committee draft stage and a revised standard is expected in the period 2019-2022.

Discussions are also underway on several issues concerning A3 refrigerants within a group standard ISO 5149 (e.g. improved charge limit for hydrocarbons below ground). However, there is currently no clear timeline for publication of the revised standard.

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Alan Lin, Head of Facility
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Photography by
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CHINESE RETAIL'S FIRST TRANSCRITICAL CO₂ SYSTEM

The installation of China's first transcritical CO₂ system in the retail sector, in a METRO wholesale store in Beijing, is just the first step in a journey that will see the German multinational fit transcritical systems in all its new Chinese stores by 2025.

— By Devin Yoshimoto, Jan Dusek & Yingwei Tao

It was a beautiful day in Beijing.

One week before the grand opening of METRO China's new Beijing Lishuiqiao wholesale store in January, *Accelerate China* could not help but notice the clear blue skies and fresh, crisp air.

Despite Beijing's international reputation as a city with high levels of pollution, the situation is now changing. The Chinese government is continuing its aggressive push to curb pollution and put the country on a more environmentally sustainable footing.

Industry leadership is crucially important in this regard. By installing the Chinese retail sector's first transcritical CO₂ refrigeration system, METRO China hopes to demonstrate the potential of natural refrigerant-based HVAC&R systems to benefit both businesses and the environment.

Inside the store, there was a palpable energy as employees rushed to finish last-minute preparations – stocking shelves, threading electrical wiring, and wiping down the glass doors of brand new refrigerated cabinets.



1 / Glass door freezer showcases

2 & 3 / Island freezer showcases

Accelerate China toured the store with key members of the METRO China team – led by Head of Facility Management Alan Lin – alongside Shanghai Fute Refrigeration & Electrical Engineering Co., Ltd. (Fute), responsible for the overall integration of the system ranging from initial design and component imports to system maintenance and staff training, to learn more.

A major milestone

METRO China's parent company, Germany-based METRO AG, is a world-leading international wholesale and food retail company that has built a global reputation as a committed player in environmental protection efforts.

The company's F-Gas Exit Program is widely seen as one of the most forward-thinking initiatives to phase out the use of HFCs in the world today.

In place since 2013, the F-Gas Exit Program aims to phase out f-gases in all METRO stores worldwide by 2030, replacing them with natural refrigerant systems where it is technically and economically feasible to do so.

At the inaugural ATMOSphere Asia conference, organised by *Accelerate* publisher shecco and held in September 2017 in Bangkok, Thailand, Olaf Schulze – METRO AG's director of energy management – updated attendees on the programme's progress.

"As of mid-2017, we have replaced fgas-based systems with natural refrigerant-based systems in more than 120 of our existing stores," said Schulze.

"Additionally, every year, we are installing around 30 subcritical or transcritical CO₂ systems in new stores worldwide. In China, to date, we have installed 28 subcritical CO₂ systems."

At ATMOSphere Asia, Schulze also took the opportunity to make a major announcement. "In the next few months, in the northern part of China, we will



1 /



2 /



3 /



Accelerate China toured the store and spoke with key members of the METRO China team.

be installing the country's very first transcritical CO₂ system to be used in the retail sector," said Schulze.

Fast-forward to today, and for the team in METRO China, this first installation of a transcritical CO₂ system represents a key milestone as they continue with their f-gas phasedown.

Thus far, the company has been installing subcritical CO₂ systems instead of f-gas-based systems. It is now beginning to transition towards using transcritical CO₂ technology as well.

2020: 'The end of R22'

"2020 will be the end of R22 for us," says Lin, METRO China's head of facility management, who oversees the installations.

Lin explains that R22 installations are already banned in new stores and that they will be completely replaced by CO₂-based systems in 2020. "We have just finalised the designs for our cascade systems, at the end of last year," he says.

"So this year we are continuing to go step-by-step towards preparing for our 2020 target with our first transcritical CO₂ system," says Lin.

"It is planned that starting in 2025, all our new stores in China will be equipped with transcritical CO₂."

Preparing for transcritical

Preparations for METRO China's first transcritical CO₂ system began around two years ago, when the team started an intensive internal research and discussion process.

METRO China worked closely with colleagues at METRO headquarters in Düsseldorf, Germany to discuss and address the most important issues: the first of which was China's high ambient temperatures.

"In China, most urban areas have different temperature ranges," says Lin. "Yet during summer, 80% of the cities will reach over 35°C."

To find out whether transcritical CO₂ technology would be viable in China's climate, Lin and his team flew to Europe last year to inspect at first hand the latest transcritical CO₂ systems already in operation.

"We learned some real cases, like in Spain, where temperatures in some cities reach over 40°C," says Lin.

"When we saw that the transcritical CO₂ systems were functioning there,

"It is planned that starting in 2025, all our new stores in China will be equipped with transcritical CO₂."

— Alan Lin, METRO China

we thought to ourselves, 'OK, we can go this way', and got the confidence to move forward."

While in Europe, Lin and his team also took the time to visit other areas and learn about the technology's latest advancements by speaking to the facility managers directly.

"We saw the actual cases and had discussions with the maintenance contractors to ask specific questions like, 'when exactly do they conduct maintenance?' or 'what are the biggest differences between transcritical CO₂ systems and other systems?'" Lin says.

Gaining an initial understanding of the technology and witnessing the systems at first hand was very important during the initial planning phase, he explains.

"It was a good thing for us to first take these past two years, with the support of our colleagues at our headquarters in Germany, to develop this understanding."

A second issue the team faced was the lack of local maintenance service providers in China.

"This was the biggest challenge," admits Lin.

"For system components like the compressors and condensers, it would be OK to have them imported. But we thought the cabinets were the most important things."

Lin highlighted the example of something going wrong with the refrigerated cabinets on the sales floor.

"If something were to break in the sales area, you can't imagine what kind of things would happen. Then if we needed to change some specific part, we'd have to send an order to Europe and wait two months – no chance," Lin says.

Only once the METRO China team had found the cabinets, the component suppliers, and the maintenance staff to service them within the local Chinese market did they decide to move forward.

Chinese retail's first transcritical CO₂ system

For this pilot transcritical CO₂ project in Beijing Lishuiqiao, METRO China decided to use a booster system - a configuration of transcritical CO₂ systems that are now widely used in the market.

"For the first store, we are taking the safe way. Our goal is to first gain a better understanding of how the transcritical system works for ourselves," says Lin.

"We'd like to find out how suitable it is for China's environment and how it can be improved."

The system itself consists of two separate transcritical booster racks, provided by Italy-based CO₂ system manufacturer SCM Frigo.

With a total cooling capacity of 334 kW, the centralised system supplies the cooling requirements for the entire store, including its fresh sales areas, freezer room, cold room, and prep room.

The system integration company selected for the project was Shanghai Fute Refrigeration & Electrical Engineering Co., Ltd. (Fute), a locally based company with several years of experience working with CO₂ systems in the Chinese market.

Commissioning was completed in December 2017, and the store celebrated its grand opening on 17 January 2018.

Key to the success of the first six months of operation, Lin explains, is training the in-store technicians and store-operation team.

In collaboration with their suppliers and contractors, METRO China will be conducting training on a constant basis for the first two years.

"Together with SCM Frigo and Fute, we created a training programme for our store, which will consist of two parts," says Lin.

System specifications

METRO Beijing Lishuiqiao

Address:
Beijing Lishuiqiao
No. 3 Chaoyang District Anli Road
100107

Shopping area: 4,100m²

Fresh sales area: 1,350m²

Freezer room, cold room, and prep room area: 420m²

One MAJA icemaker

One low- and medium-temperature rack with parallel compression, two-stage gas cooling, and heat reclaim

Low-temperature capacity: 93.50 kW

Medium-temperature capacity: 55.97 kW

One high-temperature rack with parallel compression, two-stage gas cooling, and heat reclaim

High-temperature capacity: 184.08 kW

RIGHT

1 / Transcritical CO₂ booster racks

2 / 120 bar high pressure CO₂ piping





"The first is a deep introduction to the system, for our staff, covering the basic processes needed for daily maintenance and checking," he explains.

"Second will be an ongoing training programme that will be held consistently for the next two years to help control the system, and train not just our store technicians, but technicians from other stores as well."

For this, Lin explains that Fute is scheduled to remain permanently in-house.

"Training for this system cannot be a one-off. They need to understand the transcritical system, and how it differs from normal cooling systems. We need to prepare our people," Lin says.

Set standards, reduce costs

As training gets underway, Lin and the METRO China team are now looking forward to tackling the challenges that remain.

Asked to outline the biggest challenge right now, Lin replies that initial investment costs remain a barrier. However, he does see them dropping in the near future as more suppliers enter the market.

"Right now, initial costs [for transcritical CO₂ systems] are very high compared to cascade systems," says Lin.

"So, our ambition is that we do the first one, let others see the potential, and that will encourage more newcomers to enter the Chinese market."

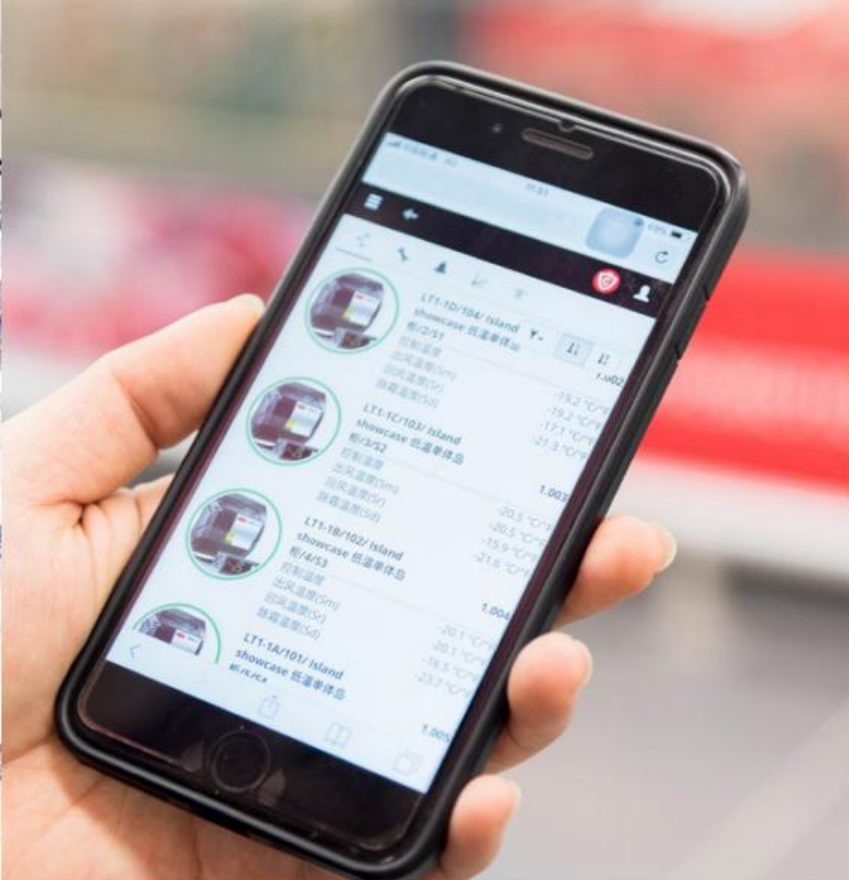
Lin is optimistic. He has seen the number of companies supplying subcritical CO₂ technology increase in recent years.

"We would like to have a list of about five suppliers for transcritical CO₂ in China, so that they can really help us roll these systems out and at the same time drive down initial investment costs," he says.

"When these systems are available at a reasonable price level, it will encourage the wider industry to use this technology."

Asked how quickly he expects this to happen, Lin replies: "In the next one to two years, we hope to see all of the key suppliers appear in the China market."

In addition to reducing initial costs, the wide availability of industry standards is key to triggering more local investment and interest in new technology.



“Our ambition is that, we do the first one, let others see the potential, and that will encourage more newcomers to enter the Chinese market.”

— Alan Lin, METRO China

TOP

Real-time system remote monitoring

LEFT

From left to right: Vigoos Fu, Fute System Design Manager / Changjin Liu, METRO China Equipment Manager / Zhiwei Tong, METRO China Group project Manager

Technology partners METRO Beijing Lishuiqiao

Overall system integration and design:
Shanghai Fute Refrigeration & Electrical Engineering Co., Ltd.

Showcases: General Fushi

Compressor racks: SCM Frigo

Compressors: Bitzer

Gas coolers: Güntner

Cool room evaporators: Güntner

Controllers: CAREL

Ice maker: MAJA

To foster this, METRO China is taking a very proactive stance, beginning to benchmark data from its stores.

"Right now, we are focused on gaining a more thorough understanding of the technology and gathering data, such as energy usage, temperature changes, and refrigeration usage, for business analysis," says Lin.

With this data, METRO China hopes to lay the foundation for new industry standards. The retailer believes that now is an ideal opportunity to work with the government and key industry associations on this task.

Spreading the wings of natural refrigerants

As for METRO China itself, more CO₂ systems are coming.

Though exact details are not yet available, Lin revealed that the wheels are now in motion for the next few installations of transcritical CO₂ systems.

"Over the next couple of years, we are planning for several more installations of transcritical CO₂ systems at both new and existing stores," says Olaf Schulze, Lin's colleague from METRO AG headquarters in Düsseldorf.

METRO China's plans to achieve its sustainability goals are not limited to the refrigeration systems, of course, but encompass the entire energy profile of each store.

"In terms of our overall energy strategy, refrigeration of course plays an important part," says Lin.

"But we also plan to have more 'green stores' in China. These green stores will need only 50% of the usual energy demand and 40% the usual carbon emissions," he adds.

“ Perhaps we have only done a very small thing. But we want this small thing to have a butterfly effect. ”

— Alan Lin, METRO China

The METRO ‘green stores’ – three of them are operating in Putuo, Jinan and Dongguan – are implementing a subcritical cooling system, closed cooling furniture, full LED (inclusive daylight usage), and smart air conditioning.

“All this reduces the electricity demand by 50%. Heat recovery will ‘produce’ the necessary heat, and the rooftop, top parking canopy and south façade photovoltaics produce electricity. This is combined with an indoor energy management system, rainwater usage system, waste management system, and for our customers, AC & DC electric vehicle chargers,” Lin says.

“Ultimately, we are aiming, in the near future, to have our first carbon-neutral store in the Chinese market.”

With this in mind, Lin is planning to visit METRO’s first zero-emissions store, in the Austrian city of St. Pölten.

The plans are ambitious and are an important step in China’s wider move towards environmental sustainability.

As METRO has already demonstrated, the passion and ambition to achieve these goals runs throughout the company. This was easy to see during the time that *Accelerate China* spent with Lin and his team.

“I think that what we are doing has the potential to change the lives of our customers, our employees...even myself,” Lin says.

“For me, personally, I think that whenever we set out to do anything, we must first let ourselves be happy. Only then can we find confidence in our jobs and be proud of our work.”

Though this is only the Chinese retail sector’s first CO₂ transcritical installation, its potential to shift the future direction of one of the world’s most dynamic and influential markets is not lost on the METRO China team.

“You know, we have to travel a lot. I’d like to see blue skies and enjoy fresh air wherever I go,” Lin reflects.

“Perhaps we have only done a very small thing. But we want this small thing to have a butterfly effect.”

“Certainly, I believe, this can be very powerful.”

■ DY, JD & YT



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NESTLÉ'S PIONEERING VISION

Swiss multinational Nestlé began replacing its CFC and HCFC systems with natural refrigerants in 1986. Today, its commitment to adopting natural refrigerants for HVAC&R applications wherever possible is helping to bring the technology to new parts of the world. *Accelerate* reports from Nestlé's hometown of Vevey.

– By Andrew Williams

From industrial refrigeration systems with NH_3/CO_2 at key production sites in Switzerland to ammonia-cooled data centres and the worldwide deployment of hydrocarbons-based display cabinets, the commitment of Nestlé to natural refrigerants is consistent and firm.

With snow-capped mountains casting their reflections in the water, visitors to Nestlé's lakeside headquarters in the Swiss town of Vevey cannot fail to be inspired by the magnificent surroundings.

Vincent Grass is a man with a vision as far-reaching as the lofty Alpine summits that tower above him on his daily commute to Vevey alongside Lake Geneva from his home in Evian, in nearby France. As refrigeration team leader in the 'corporate operations – engineering services' department at Nestlé, the Frenchman is responsible for turning the Swiss multinational's ambition to expand its use of natural refrigerants into a reality.

"We are expanding the use of natural refrigerants across the company," Grass says.

By 2020, Nestlé is aiming to reduce greenhouse gas (GHG) emissions per tonne of product in every product category to achieve an overall reduction of 35% in its manufacturing operations (versus 2010). Also by 2020, the company is aiming to reduce GHG emissions in its distribution operations by 10% (versus 2014).

Natural refrigerants have long played a central role in delivering this. Since 1992, Nestlé has invested CHF 299 million (CNY 1.99 billion) in replacing HFC systems with natural refrigerant-based alternatives for industrial refrigeration. It installed 47 new industrial refrigeration systems based on natural refrigerants in 2016 alone.

Reducing industrial refrigeration footprint

The majority of Nestlé's refrigerant consumption by charge is attributable to industrial applications.

About 90% of Nestlé's refrigerant charge – and potential risk in terms of direct refrigerant emissions – is in manufacturing. Commercial applications account for the remaining 10%.

"We're focusing on industrial because that's where we can make the biggest impact. It's where we have the biggest risk of leakage and the highest electricity consumption," says Grass.

"For most big plants, ammonia is the most efficient option. In combination with CO_2 , you can address safety issues and still deliver low temperatures. By adding CO_2 , you need more components but the compressors are smaller, so you're reducing your footprint too," he argues.

Nestlé is already using natural refrigerants for over 90% of its industrial refrigeration needs worldwide. In the Europe, Middle East and North Africa (EMENA) region,



Vincent Grass

“We’ve always been convinced that natural refrigerants are the right way to go.”

- Vincent Grass

91% of its industrial refrigeration is provided by natural refrigerants. In the Americas – Nestlé’s biggest market is the USA – the figure is 95%. “In Asia, Oceania and the rest of Africa, we’re at 84%,” Grass says.

He says it is hard to predict when the firm will achieve 100% natural refrigerants for industrial use. The official target is simply to expand their use in industrial refrigeration by 2020.

“The thing is, we have many different applications in our factories, on different scales and at different temperatures. We also have different geographies, with different climates. The cooling demand is different,” Grass explains.

“We strive to hit 100%, but we can’t say when we’ll be there. Achieving the last 10% is very difficult,” he admits.

Factors slowing down progress include lack of available technology in some countries, restrictive charge limits in some jurisdictions, and transitioning away from existing HFC systems on recently acquired sites.

“We need to look at it product-by-product and application-by-application. You have the environment, the climate, the surroundings to consider,” Grass explains.

Spring 2018 // Accelerate China

CO₂ engine room, Nescafé Factory (Orbe), Switzerland

Ammonia engine room, data centre, Bussigny

Peter Jaggy is head of engineering at Nestlé. He stresses the need to ensure that staff in headquarters and throughout the 119 countries in which Nestlé operates are on the same page. “On the fringes, there is a lot of activity which we don’t necessarily see from here in headquarters. This is why it’s not so easy to get from 90% to 100%,” he says.

The renaissance of CO₂

Nestlé’s natural refrigerants journey begins in 1986 – three years ahead of the entry into force of the Montreal Protocol on Substances that Deplete the Ozone Layer in 1989 – when the company began to replace CFCs and HCFCs with ammonia. “At that time, we focused our efforts on our biggest plants, deciding to move from CFCs directly to ammonia. Later, we extended our use of natural refrigerants to the replacement of HFCs in smaller systems,” Grass says.

In 2000, Nestlé turned to natural refrigerant CO₂ for the first time. At a factory in Beauvais, France, it replaced 15 tons of CFC R13 installed in the 1970s with an ammonia/CO₂ cascade system in which the CO₂ circulates without compression. “This was a renaissance of CO₂. It had been used at the turn of the century, but for over 50 years it had not been used at all,” Grass says.

In 2001, Nestlé opened the world's first large NH₃/CO₂ cascade system to use compressed CO₂, built in cooperation with Star Refrigeration. It replaced an R22 system at Nestlé's coffee factory in Hayes, UK.

"The valves for CO₂ did not exist at that time. HERL was a valve manufacturer in Germany back then, and they developed the valves for us," says Grass.

What is driving Nestlé's phaseout of HFCs? "In many of the countries in which we operate, there is no regulatory deadline to change. But the day the units don't match capacity any more, we need to switch to another refrigeration solution," Grass says.

"We've always been convinced that natural refrigerants are the right way to go."



Ammonia engine room, Nescafé Factory (Orbe)



Accelerate at the Nescafé Factory

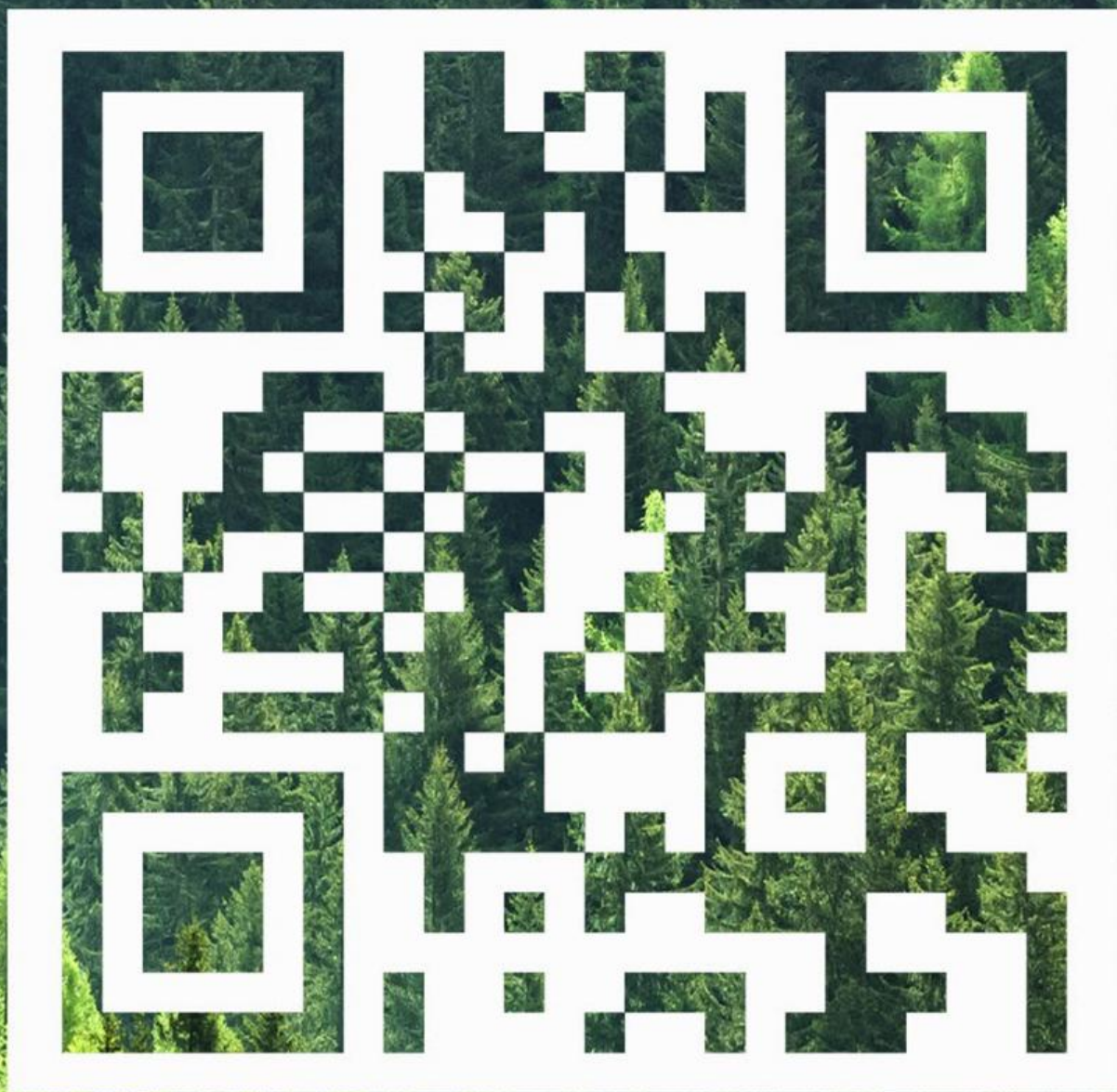
Competing with HFCs

Asked whether Nestlé has the internal expertise to make the switch to natural refrigerants, Grass says: "We have to use suppliers. We work with the key industry players around the world". Jaggy goes further: "We depend 100% on them for the execution."

Assessing the performance of Nestlé's enormous asset base helps the company's suppliers improve their systems. "Worldwide, we have over a thousand ammonia compressors running at any one time. Thanks to this asset base, we see the issues," says Grass.

One obstacle to wider use of natural refrigerant-based technologies is the cost gap with HFCs. "We have to continuously fight the battle of convincing our people that it still makes sense to do this, even if it would be cheaper to do something else," says Jaggy.

He takes the long-term view. "The efforts we're making save us a lot of money too. Yes, the initial investment may be more, for example after budgeting for safety considerations. But an industrial ammonia plant usually lasts for 30-40 years. When we opt for ammonia, we know there won't be any deadlines to phase out or replace it later," Jaggy says. ■ AW



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Business Case for
Natural Refrigerants

11-12/04/2018—Beijing



ON THE HORIZON: CHINA SIGNALS STRONG MARKET INTEREST IN NATREFS

The first ATMOSphere China Conference to be held on 11-12 April 2018 was met with strong interest by both international and domestic manufacturers, as well as the Chinese Government and HVAC&R Associations, promising a transition to natural refrigerants in the Chinese market.

– By Eda Isaksson

In response to increased market interest in natural refrigerants, ATMOSphere China, the first Chinese edition of shecco's global conference series ATMOSphere, will be held in the capital Beijing on 11-12 April 2018 in the Sheraton Grand Beijing Dongcheng Hotel, immediately following China Refrigeration 2018, the largest refrigeration technology exhibition in the Asia-Pacific, which is also taking place in Beijing on 9-11 April 2018. The event will conclude with a site visit to Chinese retail's first transcritical CO₂ system installed in a METRO Wholesale store on 13 April.

The conference will be simultaneously translated into English and Chinese, as it is aimed to serve as a bridge between Chinese businesses and the global market for natural refrigerants. One of the sessions intending to build this bridge is the Technology Leadership Round Table session, where some of the biggest international suppliers in the world will get on the stage to share some of the obstacles they've faced in China and discuss their future plans and opportunities in this vast market.

ATMO China will delve deeper into the state of the Chinese HVAC&R market, which is currently in a transitional stage after the global agreement

reached to phase down HFCs under the Montreal Protocol. Conference presentations will showcase the value of leapfrogging from HCFCs to natural refrigerants in response to the global phasedown.

The Chinese Ministry of Environmental Protection and its Foreign Economic Cooperation Office will be presenting the latest updates on regulatory issues related to natural refrigerants in China during the Policy Session. The United Nations Industrial Development Organisation (UNIDO) will also be speaking in this session, offering a more international dimension on the topic.

In addition, presentations from leading HVAC&R associations, end users, and technology suppliers underscores the event's importance as a milestone showcasing China's accelerating transition towards the use of natural refrigerants. ■ EI

For more, see the programme on the next page or visit: <http://www.atmo.org/china2018>





ATMO sphere

Business Case for Natural Refrigerants

11-12/04/2018—Beijing

PROGRAMME

DAY 1 - WEDNESDAY 11 APRIL

15:30 / Registration

16:00 / Welcome and Introduction

16:20 / Technology Leadership Round Table

A strategic discussion about the future of the market and technology.

18:30 / Networking Drinks Reception

19:30 / Networking Dinner

Sponsored by Danfoss, Dorin, Carrier

DAY 2 - THURSDAY 12 APRIL

08:00 / Networking Breakfast

Sponsored by Embraco, Nidec, Castel, Epta, Huayi, Eliwell

09:00 / Policy Session

Latest regulatory policies for natural refrigerants in China and the world.

10:15 / Networking Break

Sponsored by Conex Bänninger, SCM Frigo, Frascold, Carel, Scantec, Lu-ve

10:45 / Chinese HVAC&R Associations Session

Chinese associations introducing their position and work with natural refrigerants.

12:00 / Networking Lunch

Sponsored by Embraco, Nidec, Castel, Epta, Huayi, Eliwell

13:00 / Future of the Industry End User Panel

End users sharing their experiences and future plans with natural refrigerants.

14:30 / Networking Break

Sponsored by Conex Bänninger, SCM Frigo, Frascold, Carel, Scantec, Lu-ve

15:00 / Technology Case Studies Part 1

16:15 / Networking Break

Sponsored by Conex Bänninger, SCM Frigo, Frascold, Carel, Scantec, Lu-ve

16:30 / Technology Case Studies Part 2

DAY 3 - FRIDAY 13 APRIL

09:30 / Site Visit to Metro Beijing Wholesale Store

ORGANISATIONS SPEAKING



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LEADER OF THE RACK

With 69 installations, ALDI is the No. 1 user of transcritical CO₂ refrigeration systems in the U.S. supermarket industry, and its aggressive store expansion and remodelling plans call for even more.

– By Michael Garry & Andrew Williams

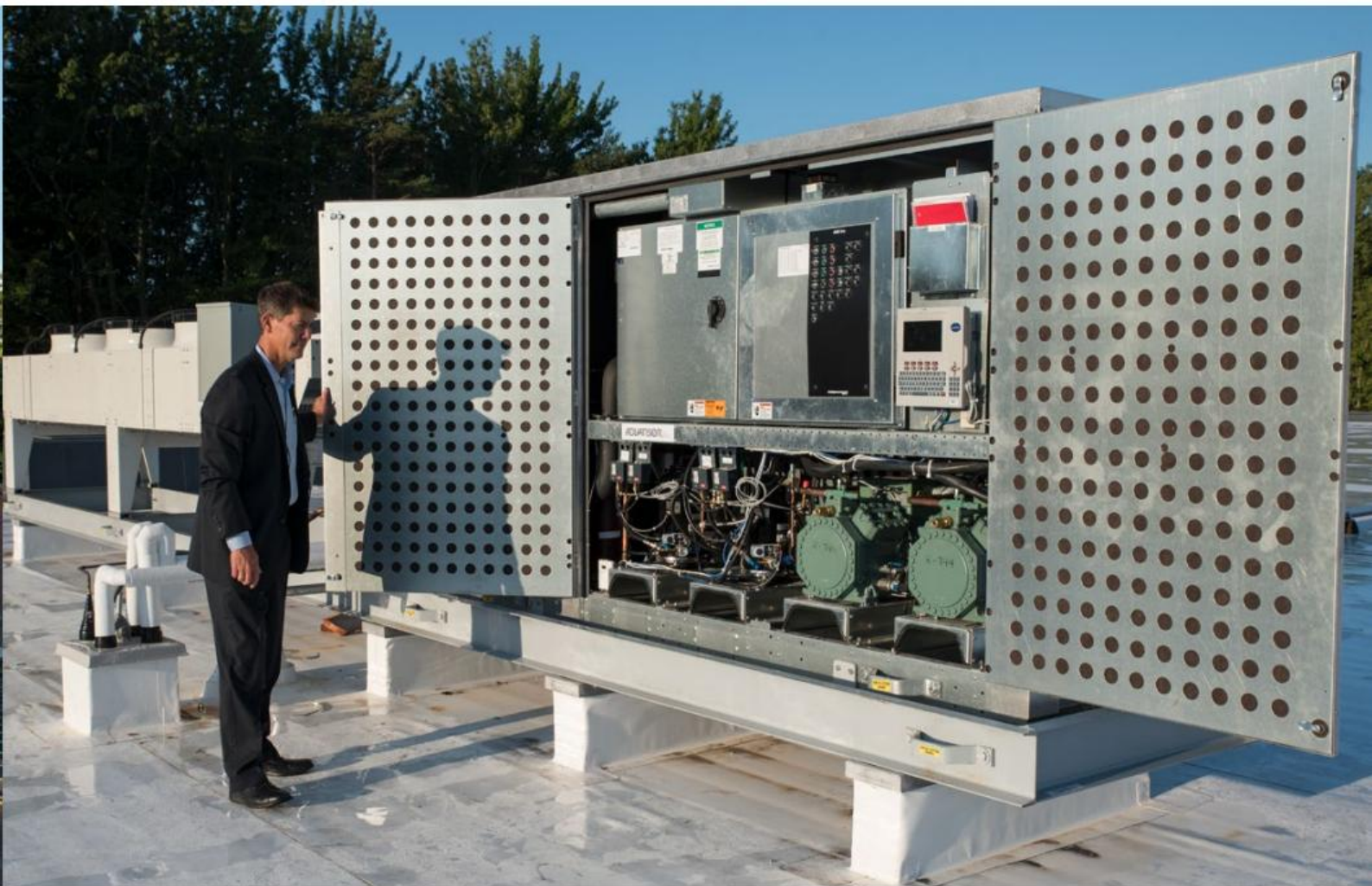
When Hillphoenix introduced the AdvansorFlex – a smaller capacity, less costly version of its Advansor transcritical CO₂ booster refrigeration system – in December 2015, the Conyers, Georgia-based OEM had in mind small-format stores as the primary end user.

Enter ALDI US, the fast-growing chain of nearly 1,700 value-oriented supermarkets in 35 U.S. states. The Batavia, Illinois-based company had already started installing Hillphoenix's Advansor system prior to the AdvansorFlex's release, but then switched to the smaller system.

"Hillphoenix engineered the AdvansorFlex specifically for ALDI stores, which have smaller footprints [about 20,000 sq. ft.; 1,858 sq. m.]," said Aaron Sumida, an ALDI US vice-president based in upstate New York. "The Advansor CO₂ booster system is better suited to traditional supermarkets."

As of 11 August 2017, ALDI had deployed transcritical CO₂ systems – the majority of them the AdvansorFlex – in 69 stores, with more installations coming.

Hillphoenix supplied 66 of the stores, with the other three using transcritical systems provided by a partnership between Hussmann and Canadian OEM Systèmes LMP. More than 10 projects so far



Aaron Sumida, ALDI US VP, Viewing inside of AdvansorFlex

have been in remodelled stores. The rest of the systems were installed in new locations. In stores without CO₂ refrigeration systems, ALDI currently uses R448A.

With 69 installations, ALDI is the No. 1 user of transcritical CO₂ refrigeration in the U.S. supermarket industry. In North America, it's second only to Sobeys, which has approximately 100 stores with a transcritical system.

Known for its low prices (up to 50% lower than those of traditional stores, the company says), private brands and no-frills, efficient operation, ALDI US is a 41-year-old independently operated member of Mülheim, Germany-based ALDI South (Süd). Facing growing competition in the U.S. from traditional grocers and other Europe-based retailers, ALDI has announced store development plans that are nothing if not ambitious. By the end of 2022, it expects to have nearly 2,500 stores, funded by a US\$ 3.4 billion capital investment plan, putting it third in the U.S. in store count behind Walmart and Kroger.

In July the chain opened a store in Baldwinsville, N.Y., overseen by Sumida, that runs an AdvansorFlex system.

The retailer has announced a US\$ 1.6 billion plan to remodel and expand more than 1,300 existing U.S. stores by 2020. Remodelled stores will feature a modern design, open ceilings, natural lighting and environmentally friendly building features.

IMMENSE IMPACT OF CO₂

In the U.S., ALDI has set a corporate goal of reducing greenhouse gas emissions by 30% per square metre of sales floor by 2020 compared to 2012. The potential emissions-reducing impact of installing transcritical CO₂ systems "is immense," said Sumida.

Replacing R404A, or even the lower GWP refrigerant R407A, with CO₂, he pointed out, means that the warming impact of a leak is reduced by 1/3,900th or 1/1,900th respectively. "Our stores are our primary source of emissions, so this can only help us meet our goal," he said.

ALDI US started installing transcritical CO₂ systems in earnest when it entered the southern California market in March 2016, and now uses them in new stores and major remodels in four of its 24 divisions – California, New England (Connecticut, Massachusetts, New Hampshire, Rhode Island and Vermont), New York and Virginia.

In 2015, ALDI joined GreenChill, which calls on supermarket members to set emissions-reduction goals, report annual emissions, and work to improve existing and future store refrigeration and HVAC equipment.

As of August 2017, 43 of ALDI US's 69 transcritical stores had been awarded GreenChill Platinum certification by the U.S. Environmental Protection Agency's GreenChill Partnership, with more new and remodelled transcritical stores in the process of receiving this certification.

Aaron Sumida
ALDI US VP

Photography by
Ben Cleeton.



ALDI US has not set a deadline to fully commit to CO₂ transcritical refrigeration systems, but “it’s our long-term objective to standardise,” said Sumida. With about 800 new ALDI stores to open in the U.S. by 2022, each of the company’s 24 divisions will begin to phase in CO₂ transcritical systems – including the 18 not currently committed to it – “to ensure preparedness by the refrigeration installers and technicians,” he added.

Why did ALDI US choose to install transcritical systems? “We genuinely believe that natural refrigerants are the best long-term solution,” said Sumida. While ALDI US operates independently, it has also followed the example of ALDI South stores in Europe. In February 2017, ALDI South made public that the company had installed its 1,000th store with a CO₂ system, representing 54% of its outlets; the UK division of ALDI South has also announced that it will convert all its roughly 700 stores to CO₂, starting with 100 by the end of 2018.

“ALDI stores in other countries also use CO₂ systems as a standard and have set a strong precedent in the natural refrigerants category,” Sumida noted. “ALDI in other countries serves as a resource for us. Some of the best examples for many of our environmental tests and initiatives begin with what other ALDI South group countries are doing. This collaboration across countries continues to drive results.”

ALDI’S PRIMARY REFRIGERATION SYSTEM

The AdvansorFlex – the primary refrigeration system for new and remodelled stores in four of ALDI’s 24 divisions – represents the latest chapter of Hillphoenix’s natural refrigerants journey.

A longtime provider of secondary and cascade CO₂ systems, Hillphoenix entered the all-CO₂ transcritical refrigeration category in 2011 with the acquisition of Danish OEM Advansor, a major supplier of transcritical systems to the European marketplace.

By 2012, Hillphoenix had begun manufacturing its own Advansor-branded transcritical racks at its Georgia headquarters. By mid-2017, Hillphoenix had installed close to 300 transcritical racks in North America – out of a total of about 410 – the most of any OEM.

Contributing significantly to that growth is the AdvansorFlex, a smaller capacity, less costly (by 20%-30%) version of the original Advansor system, designed for small-format stores (though it can be used in larger formats as well as in multiples). Introduced in December 2015, the AdvansorFlex was specifically designed for the North American marketplace to meet stringent UL/cUL requirements and North American safety codes.

Like all transcritical systems, the AdvansorFlex’s efficiency depends on its location; it is up to 18% more efficient than an HFC unit in cooler climates, says Hillphoenix, but its efficiency decreases in warmer climates. However, Hillphoenix has installed AdvansorFlex units with efficiency-improving adiabatic gas coolers in southern U.S. locations.

AN ENERGY BENEFIT

Sumida acknowledged that there is a 20%-30% increase in upfront cost associated with the CO₂ transcritical systems compared to conventional HFC rack systems. However, ALDI anticipates a financial gain over the lifetime of the transcritical system, considering “avoided refrigerant phaseouts and reduced cost of refrigerant,” he said.

ALDI shares its environmental accomplishments and progress in an environment section on its corporate responsibility website and on its social media channels. In Platinum-certified stores, said Sumida, “we also proudly display our EPA GreenChill Certification plaque” – representing the firm’s industry-leading investment in transcritical CO₂ refrigeration. ■ MG & AW

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RIDING THE HYDROCARBON WAVE

From global beverage giants to European supermarkets, a growing number of companies worldwide are taking advantage of the efficiency and versatility of hydrocarbons.

– By Andrew Williams & Devin Yoshimoto



As an alternative to HFCs, hydrocarbons are considered to be one of the most efficient options in terms of energy consumption. Their impressive thermodynamic properties lend themselves especially well to applications in the commercial and light commercial refrigeration markets.

The adoption of hydrocarbons is expected to accelerate even more quickly as governments around the world impose stricter energy-efficiency standards on manufacturers. Some HVAC&R manufacturers are responding by doubling down on their investments in hydrocarbon-based systems.

MULTINATIONALS MOVING THE MARKET

Global beverage giant the Coca-Cola Company is aiming to be 100% HFC-free for all new cold drinks equipment by the end of 2020. It plans to achieve this target by primarily adopting natural refrigerants CO₂ and hydrocarbons – with its Japanese branch leading by example.

Globally the Coca-Cola Company is already adopting natural refrigerants on a grand scale. By the end of 2015, it had deployed more than 1.8 million HFC-free units worldwide. By HFC-free, the Coca-Cola Company means 100% natural refrigerants.

In Japan, the beverage giant has adopted an official target of moving to 100% natural refrigerants – meaning hydrocarbons or CO₂ – in all vending equipment on the Japanese market by 2020.

Local Coca-Cola bottling companies operate some 980,000 vending machines in Japan. Stan Mah – representative director and president of Coca-Cola Tokyo Research & Development Inc., a subsidiary of the Coca-Cola Company – estimates that the lifecycle of this equipment is eight years. “We should be able to replace our entire fleet by 2020,” he says.

Brewing giant Heineken also recognises the business case for natural refrigerants. CEO Jean-François Van Boxmeer argues that sustainable refrigeration is one of the best investments that companies can make in the future of the planet.

The Heineken Group, the second-largest brewer in the world by revenue, is setting ambitious climate goals to reduce its emissions of greenhouse gases. Van Boxmeer recognises HFCs as one of the world’s fastest-growing climate pollutants and a major source of greenhouse gas emissions today.

The group is cutting down on its use of HFCs by switching to fridges based on hydrocarbons instead. “By 2020, we will have cut the CO₂ emissions of our fridges in half compared to 2010,” says Van Boxmeer.

HYDROCARBONS MAKING INROADS INTO FOOD RETAIL

In the United States, Minneapolis-headquartered Target Corp. now has self-contained display cases using R290 in more than a thousand stores. “Target has been evaluating alternative refrigerants for several years and has determined that R290 is the preferred self-contained refrigeration solution,” said Paul Anderson, the retailer’s senior director of engineering, at the Food Marketing Institute’s Energy & Store Development Conference in Orlando, Florida last year.

In Europe, technological innovation, regulatory change and the drive to reduce energy consumption are steering retailers towards hydrocarbons. Lidl, for example, is already using propane in all new plug-in refrigerated units throughout its German stores. It is committed to rolling out R290 in all future installations across Europe.

Natural refrigerants are also helping the Colruyt Group to save money and deliver its environmental targets, with the Belgian retailer moving to hydrocarbons for 100% of its in-store cooling needs. Founded in 1925, the Colruyt Group – headquartered

in the town of Halle near Brussels – is one of Belgium's biggest retailers, with annual revenue of over €9.1 billion. Employing over 29,000 staff, it boasts over 500 shops.

Three shop formats in Belgium have product cooling: Colruyt supermarkets, OKay convenience stores and Bio-Planet organic stores. With the Group having already switched to electricity from 100% renewable sources, refrigeration now makes a proportionally larger contribution to its carbon footprint. Choosing the right refrigerant, therefore, is crucial for meeting its sustainability targets.

The Colruyt Group's ultimate goal is to become HFC-free. In 2012, it launched a feasibility study. This led to the adoption in December 2014 of the official target of using 100% natural refrigerants for all its cooling needs. Since the end of 2016, the Group is no longer building HFC cooling systems in its stores.

At the Colruyt system's heart are compact chillers containing less than 2.5 kg of propane or propene. With a refrigeration capacity of 30-50 kW, one chiller can cool the Group's smaller OKay (convenience) and Bio-Planet stores. Colruyt supermarkets need to run two compact chillers. An extra chiller is always added redundantly, ready to step in should one chiller fail.

Colruyt supermarkets also feature special cold rooms in which customers choose fruit, vegetables and other products from shelves. There are no refrigerated cabinets.

Air handling units above the cold room remove the air inside, cool it down with glycol, and put it back in through perforated walls, creating a temperature of 3-4°C on the shelves and 7°C in the room. Constantly circulating cold air negates the heat given off by from customers and the surrounding shop.

At the entrance of the cold room, an air curtain stops the cold air from escaping by blowing air at room temperature from a vent above the cold room's open doorway. Rather than mixing together, the warm and cold air roll against and away from one another – creating an 'air door' that pushes the cold air back into the cold room. This principle is used in all new OKay and Colruyt stores.

UNILEVER OPTS FOR HYDROCARBONS

Dutch-British transnational consumer goods giant Unilever is also committed to natural refrigerants. It made the decision to adopt hydrocarbons in 1999, after having also considered CO₂.

Berty Jakob, senior research and development manager at Unilever, shared the company's experience of using hydrocarbon refrigeration equipment. "In the area of refrigerants, we made a commitment in the year 2000. And by 2014 we already had over 12,000 hydrocarbon cabinets in place. We were very consistent and persistent in the way we moved ahead," said Jakob.

Fast forward to 2016, and Unilever had 2.2 million hydrocarbon cabinets. It prefers to use hydrocarbon refrigerants R290 and isobutane (R600a) for low-temperature applications.

"Regarding the implications for servicing it is important to ensure that service engineers are skilled and properly trained for working with hydrocarbons. Training of service personnel is key. Do it right first time and it will serve you for years to come," Jakob said.

Unilever find hydrocarbon cabinets to be equally as reliable as their HFC-based counterparts. "We have more than 10 years' experience of working with hydrocarbon cabinets, and we have never had any safety issue," Jakob said.

Hydrocarbons, then, are set to play an important role in the retail cooling landscape of the future. ■ AW & DY

1 / Collin Bootsvelde, Colruyt Group

2 / Paul Anderson, Target.



1 /



2 /

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BOLD NEW HORIZONS

Technology integration and increased competition between ammonia, hydrocarbons and CO₂ will help grow the market for natural refrigerant-based HVAC&R solutions in 2018 and beyond, according to key industry figures around the world. *Accelerate China* reports.

– By Andrew Williams, Michael Garry & Charlotte McLaughlin

The coming months promise to be eventful for the HVAC&R sector as countries prepare for the entry into force of the Kigali Amendment to the Montreal Protocol in 2019.

The Kigali Amendment on phasing down the production and use of HFCs – which applies to all 197 Parties to the Montreal Protocol – only becomes legally binding for individual signatories once they have formally ratified it.

CLEAR MARKET SIGNAL

HFCs are widely seen as the world's fastest-growing climate pollutant and are used in air conditioners and refrigerators. The Kigali Amendment sees developed countries take the lead on phasing down these potent greenhouse gases, starting with a 10% reduction in 2019 and delivering an 85% cut in 2036 (compared to the 2011-2013 baseline).

Kigali splits developing countries into two groups. The first one – which includes China and African nations – will freeze consumption of HFCs by 2024, with their first reduction steps starting in 2029. A second group including India, Iran, Iraq, Pakistan and the Gulf countries will meet a later deadline, freezing their use of these gases in 2028 and reducing consumption from 2032.

The imminent entry into force of the Kigali Amendment establishes a clear HFC phase-down schedule, giving a strong message to the HVAC&R sector to provide the technology solutions – including natural refrigerant-based equipment – that will deliver the Kigali targets.

INTEGRATION OF REFRIGERATION & HVAC

Observers of the market for natural refrigerants such as CO₂, ammonia and hydrocarbons expect the trend towards integrating refrigeration and HVAC to intensify in 2018. Technological advances, meanwhile, will trigger wider uptake of natural refrigerants in different fields of application.

"2018 will be a fantastic year for the introduction of CO₂ in commercial refrigeration," Enrico Zambotto, responsible for customer and product support at Italian commercial refrigeration equipment manufacturer Arneg, told *Accelerate China*. "We're going to see different solutions like parallel compression, [standard] ejectors, heat recovery systems, integrated HVAC, pumped CO₂ and CO₂ condensing units."

Danish manufacturer Advansor also notes this trend. "We'll see the newest technologies such as integrated systems, ejectors and rotary compressors become standard in the market," says co-founder Kim G. Christensen.

North American manufacturers are also optimistic that 2018 will be a positive year for CO₂.

"For 2018, the energy savings aspect should be more apparent as we are starting to see [CO₂ transcritical] installations using ejectors, sub-cooling, parallel compression and simplified control strategies," says Jeff Gingras, president of Canadian firm Systèmes LMP.

"The Canadian market has adapted natural refrigerant technology as all initial quotes for commercial and industrial are based on CO₂. This is the future. We foresee an increase in demand once again in 2018," Gingras says.

André Patenaude, director (food retail growth strategy, cold chain) at Emerson Commercial and Residential Solutions, foresees that, "Canadian supermarkets will move ahead with CO₂ transcritical".

American contractor Climate Pros sees some end users moving more slowly than others in the United States. "A few of our customers who were using some CO₂ are making indications that they may be moving into CO₂ across the board very soon, so we shall soon see," says CEO Todd Ernest.

End users are helping to drive this trend. Whole Foods Market's director of sustainability and facilities, Tristram Coffin, believes, "the needle has already begun to move on ejector technologies and advanced control strategies for CO₂ transcritical systems".

"With the right design strategy, my hope is we can keep these systems from ever going transcritical as the ambient temperature rises. It will be nice to see ejectors make more of a splash here in the U.S. in the next year," Coffin says.

NEW APPLICATIONS

Some market observers predict that CO₂ is poised to make a big splash in new applications and in new parts of the world.

"CO₂ heat pump discussions in North America will begin, and demonstration projects will start gaining popularity," predicts Emerson's Patenaude. He also sees the industrial market gaining ground. "Larger-capacity CO₂ compressors for medium-temperature and low-temperature applications" will develop, he says.

Compressor manufacturer *Officine Mario Dorin* is confident it has the largest compressor for CO₂ available on the market at 80 horsepower.

CO₂ will be "booming, especially for large applications, such as warehouse, process cooling and the like," says Giacomo Pisano, Dorin's sales manager.

Yet this year may not just be about how big CO₂ can go. "We will see CO₂ refrigeration systems with wider capacities ranging from only a few kW to MW, and systems being even more compact and even more simple and service-friendly," notes Advansor's Christensen.

The Danish company's racks adorn what is thought to be the world's largest CO₂ transcritical installation, with a total capacity of over 3.36 MW), at a Staay Food Group processing plant in the Netherlands.

"We strongly believe that CO₂ will get the highest market share both in commercial and industrial refrigeration," Christensen says.

He is not the only key player expecting CO₂ to make greater inroads into the industrial arena.

"I predict increasing momentum toward CO₂ systems (both subcritical and transcritical), and to a lesser extent toward low-charge ammonia in new construction," says Pete Lepschat, engineering services manager at U.S.-based Henningsen Cold Storage.



1 /

Henningsen has carved out a reputation for reducing the ammonia charge in some of its warehouses by eliminating components and using evaporator coils with low overfeed ratios.

The food and beverage industry, meanwhile, is fast realizing that packaged natural refrigerant solutions "are able to [deliver] real project savings and come out the other end with a lower cost of ownership," according to Kurt Liebendorfer, vice-president of U.S.-based Evapco, a provider of packaged low-charge ammonia solutions.

"We ended 2017 with some very exciting new orders and are starting 2018 with additional orders," Liebendorfer told *Accelerate China*.

Jesper Olsen, application expert (refrigeration) at Alfa Laval, predicts that this year will be a prosperous one for natural refrigerants. "Ammonia heat pumps will have a big boom and we will be prepared," Olsen says.

He expects the reduction in Europe's HFC quotas under the new EU F-Gas Regulation to help facilitate the shift towards natural refrigerants, "at least in the second half of 2018".

Stefan Jensen, managing director of Scantec, has had huge success with low-charge ammonia in Australia. "We expect to complete at least an additional five low-charge NH₃, central-style, dual compression stage refrigeration plants in 2018, taking the total number of systems completed so far to 19 since the technology was first launched in 2012/13," Jensen told *Accelerate China*.

2018 marks the entry into force of Australian legislation to phase down HFCs.

Nonetheless, Jensen predicts that progress in Australia will be slow. "An acceleration of the market for natural refrigerant technology is likely to require a larger reduction of the HFC import quota than is planned for the next two to four years," Jensen said.

1 / Whole Foods Market's director of sustainability and facilities, Tristram Coffin.

2 / André Patenaude, director, Emerson Commercial and Residential Solutions.

NATREFS TO COMPETE WITH ONE ANOTHER

André Patenaude, director (food retail growth strategy, cold chain) at Emerson Commercial and Residential Solutions, thinks there will be a mix of solutions on the market. "NH₃, NH₃-CO₂ cascade, or CO₂ booster systems may be seen as a viable, non-intrusive option to retrofitting existing HCFC facilities as well as in new [industrial] facilities," Patenaude says.

"NH₃-CO₂ cascade systems are starting to displace NH₃ in industrial blast freezing and holding freezer applications. There will be availability of larger-capacity subcritical low-temperature CO₂ compressors, enabling faster adoption," he says.

Beat Schmutz, managing director of Swiss system designer SSP Kälteplaner, agrees natural refrigerants are becoming increasingly competitive with one another in a range of different applications. "CO₂ will increasingly be used in the industrial environment in addition to ammonia plants," Schmutz notes.

Dorin's Pisano foresees some movement to large-capacity CO₂, but predicts that the market for natural refrigerant technology will remain "stable for ammonia".

2 /



HYDROCARBONS ON THE RISE

2018 will be a year of continued growth for hydrocarbons in light commercial refrigeration systems following impressive market progress in 2017, according to some observers.

"In 2018, I see the growth of R290 (propane) applications in small-size applications," says Marek Zgliczynski, manager (commercial refrigeration product engineering), Embraco. "This trend is visible already in the most recent products sold in 2017."

Emerson's Patenaude agrees that the adoption of self-contained propane equipment will continue to grow around the world in 2018.

Regardless of the confusion surrounding a court decision to prevent the U.S. Environmental Protection Agency's (EPA) delisting of HFCs under the SNAP (Significant New Alternatives Policy) program, Charles Hon, engineering manager at True Manufacturing, says his company will forge ahead with its plan to make 100% of its equipment use propane.

"We are continuing to increase our sales of R290, and finalising more redesigns of equipment. Most of the industry is holding back, hoping the [EPA's] SNAP reversal will hold up in court. The few companies that are moving forward are being driven by customers," Hon says.

Some observers expect bodies such as AHRI, the IEC, ASHRAE, UL, CEN-CENELEC and the EPA to announce new charge limits for hydrocarbons in the coming years.



Menno van der Hoff, head of R&D and manager HVAC at Uniechemie, and *Accelerate Europe* Person of the Year.

BREAKING INTO HVAC

Menno van der Hoff, head of R&D and manager HVAC at Uniechemie, believes more must be done to encourage the use of hydrocarbons in applications beyond commercial refrigeration, like HVAC.

"Why? The EU F-Gas Regulation does not force them to say goodbye to [the HFCs] R410A or R134a and the costs of refrigerants is a minor percentage of the total cost of a [variable refrigerant flow air-conditioning system] VRF or chiller. So, a large change will not take place. Only early adopters or green customers will pull the market," Van der Hoff explains.

He also notes that the fragmentation of the market makes it difficult to communicate the benefits of adopting natural refrigerants. "Investor, architect, specifier, component manufacturer, production, consultant, main contractor, M&E contractor, subcontractor, commissioner, tenant, owner – it's such a complex chain," he says.

Van der Hoff places some hope in the Chinese market. "I expect the market for HVAC to develop into propane solutions in larger volume only if Chinese RAC producers do not move into R32," he says.

"Another issue is to clarify and warn the market about the dangers of HFOs. There is too much unknown about environmental safety," he cautions.

"For 2018, we will continue to focus on propane as the most efficient choice for low-temperature heat pumps. People will see more brands on propane, in particular for chiller, mobile and split solutions," Van der Hoff predicts.

2018 looks set to be an exciting year for natural refrigerants in a range of applications worldwide. Keeping reading *Accelerate* to track the development of these trends in different parts of the world! ■ AW, MG & CM

Embraco's Zgliczynski does not see hydrocarbons fulfilling their potential as competitors to HFCs until these limits have increased. "For bigger size cabinets/compressors, the transition blends are still the main interest, since the [charge-increase] legislation is not ready yet for R290 or A2Ls," he says.

Emerson's Patenaude believes that, "impending increased charge limits for A2L and A3 refrigerants may drive development of higher-capacity equipment".

Whole Foods Market is one end user that would be happy to see the charge limits increase. "I am optimistic that policy regarding hydrocarbon charge limits will slowly but surely begin to move in the right direction in 2018 and beyond," says Tristram Coffin.

"As for adoption, to me going natural is a no brainer. Why wait? The sooner you adopt, the more experience and practice you get, which means the sooner you perfect system operations. I trust others in the industry will begin to share that mentality," Coffin says.



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NATREFS AT HEART OF NEW CHINA RETAIL ERA

The China Chain Store & Franchise Association is confident that natural and other low-GWP refrigerants will play a central role in moving China into a new era of retail.

— By Devin Yoshimoto & Yingwei Tao

The China Chain Store & Franchise Association (CCFA), China's leading retail association, expects natural refrigerants to help put the country's rapidly changing retail industry on a more environmentally sustainable footing.

The CCFA currently represents more than 1,000 members who together boast about 356,000 stores, in the retail, catering and hotel service industries.

Accelerate China hears from the CCFA about its top priorities in 2018, major trends currently shaping Chinese retail, and the key role that natural refrigerants-based HVAC&R technology will play in the future.

INCREASING SOCIAL AND ENVIRONMENTAL FOCUS

As the Chinese government continues to emphasise social and environmental sustainability, the industry is responding by identifying the technology solutions that will ultimately have a positive impact on society.

"The focus of next year's work will be on two main areas," says CCFA.

"The first is seeking out new trends in the development of technology for retailers. It is our top priority in 2018 to gather good case studies in the application of new technology."

"Secondly, new standards and regulations are needed for the entire retail industry to focus on sustainable development."

CCFA explains that sustainability in this sense not only refers to the growth of individual businesses, but ultimately to the wider impacts of their growth on society and the environment as a whole.

"The key point here is to consider social costs and social values, and to look beyond the industry's own interests."

GROWING AWARENESS OF NATURAL REFRIGERANTS

It is at this cross section that the CCFA hopes to raise awareness among its members of the benefits of natural-refrigerant technology.

"It is certainly expected that the use of natural refrigerants will outperform traditional refrigeration systems in terms of energy efficiency and performance," says the CCFA.

"In addition, they will not only reduce carbon emissions but also reduce product lifecycle costs."

The CCFA recognises the benefits of the technology in the context of global policy to regulate the phasedown of HFCs.

"Refrigerants used in the refrigeration systems of the retail industry will also be gradually replaced by low Ozone Depletion Potential (ODP) and Global Warming Potential (GWP) substances in order to meet the requirements of the Montreal Protocol," it says.

The association acknowledges, however, that challenges such as high initial costs and the lack of trained technicians remain a barrier for the industry.

"The application of green refrigerants in China's retail industry is in an early stage."

"At the present time, the technical capability of personnel is weak, the cost of equipment investment is high, and the application of the technology is not universal."

The CCFA hopes to contribute to solving these issues by first working to raise awareness in the industry.

In 2016, it published a paper entitled '*Proposal on Promoting Environmental Protection Refrigerants in China's Retail Industry*'.

The goal of the paper, the CCFA explains, was to "call on the industry to urge retail industry stakeholders to promote low-energy consumption in stores while also paying attention to the protection of the ozone layer and also to actively promote environmentally friendly cold chain technology".

"In the future," CCFA says, "we will continue to work with retailers, equipment service providers, standards-setting parties and relevant government departments to further accelerate the application of green refrigerants in the retail industry".

FRESH FOOD TREND DRIVING OPPORTUNITIES FOR NATREFS

Despite the challenges, market trends are quickly increasing the number of opportunities for natural refrigerants in China's retail sector.

"2017 was the most intensive period for offline/online investment ever, which is quite different from the past," the CCFA says.

Last year was seen as an unprecedented year in the amount of convergence between the online and offline worlds of China's retail industry.

This trend is now widely seen as heralding a new era for retail in China that is bringing new opportunities, especially for natural refrigerants.

"In terms of fresh food, consumer demand for higher quality and fresh foods is now increasing and it is driving opportunities for the refrigeration and HVAC industry."

CCFA explains that the higher demand for quality is driving businesses to look more closely at their investments in cold chain and refrigeration technology.

"There are many aspects to the process of enhancing the quality of fresh produce that can be improved, for example product safety and quality control."

"Retailers are also required to increase their investment in fresh-keeping technologies, especially for refrigeration equipment. Cooling capacity of equipment systems will also increase, and more new technologies will be needed to provide innovative solutions."

"For retailers, especially those that deal with fresh and frozen refrigerated goods, we see that, due to the new policies of environmental protection, the demand for natural refrigerant-based technology is increasing day-by-day."

As the CCFA continues to work to support its members with the information and knowledge they need to adapt to China's new era of retail, it is also looking forward to seeing this trend manifested at its events.

CHINASHOP is Asia's leading retail industry event, and it is organised by the CCFA.

"In 2017, CHINASHOP set new records, topping 90,000 square metres of exhibition area for the first time and attracting more than 55,000 attendees over the span of three days."

CHINASHOP 2018 is set to be the ideal platform to assess the progress of natural refrigerants in the retail sector.

"The technology exhibited at CHINASHOP is based on the needs of retailers. We believe that in the next few years, natural refrigerant-based technology will shine at the show." ■ DY & YT



Humble beginnings, a bright future

China has already come to grips with hydrocarbons in domestic refrigeration. The light commercial market is next.

– By Charlotte McLaughlin & Devin Yoshimoto

The success of hydrocarbons in domestic refrigeration partly boils down to an unlikely tale of an NGO, an old German factory and a campaigner named Wolfgang Lohbeck.

The entry into force of the Montreal Protocol in 1989 marked the beginning of the end for chlorofluorocarbons (CFCs) – which first created the hole in the ozone layer – and HFCs were looked on as the major alternatives.

Greenpeace and energy expert, Wolfgang Lohbeck – also known as Wolo – decided to start the ‘GreenFreeze’ refrigeration project in 1992.

“[Wolo] was the right person at the right time. The world is a better place because of his work,” Janos Maté, a senior consultant in Greenpeace International’s political business unit who worked with him on the project, told *Accelerate China*.

Wolo met scientists in Dortmund, Germany who showed him that switching to hydrocarbon refrigerants such as isobutane and propane was a viable option for the household sector. He found a fridge manufacturer called DKK Scharfenstein, which was about to go bankrupt, and convinced it to start working on hydrocarbon fridges. The rest is history.

Within a year, his initiative had resulted in the highly successful commercialisation of so-called ‘Greenfreeze’ hydrocarbon refrigeration in Germany. The technology spread rapidly. “Greenpeace now estimates that currently there are between 900 million and one billion domestic hydrocarbon (‘GreenFreeze’) refrigerators in the world,” Maté says.

Household refrigerators in China are already largely based on hydrocarbons. “Most [household] appliances use R600a [isobutane], which is a natural refrigerant,” Jason Qian, Greater China sales and marketing director for Brazilian compressor manufacturer Embraco, told *Accelerate China*.

Chinese compressor manufacturer Huayi Compressor Co., Ltd. already sells 18 million hydrocarbon-based compressors for household applications per year in China. In 2018, the firm expects that figure to grow to 20 million, according to David Zhu, marketing manager for Huayi Compressor Co., Ltd.

“R600a will soon be used in 100% of household fridges,” Zhu predicts.

Commercial refrigeration is expected to be a harder nut to crack than the household market, which has converted almost fully to hydrocarbons.



Light commercial products like freezers, displays cases and bottle coolers mainly still use R134a in China.

Some manufacturers of compressor and display case technology believe much remains to be done to help OEMs and end users in China to switch from f-gases to propane for light commercial refrigeration.

Embraco's Qian sees two major challenges: a lack of knowledge and education among small Chinese OEMs, and difficulties in actually providing the professional service and know-how required by these companies.

The majority of the Chinese market for hydrocarbon-based compressors consists of small OEMs.

"The application of propane as a refrigerant is becoming mature with the big OEMs, but the majority of the market is not yet aware of this importance. They don't know how to start," Qian explains.

"They have to upgrade their facilities, upgrade their production lines, all without the full range of knowledge about natural refrigerants. So how we can help them manage that transition and increase awareness and education is the key."

Qian adds that these small companies also need professional service to help them integrate the new technology into their products. This is the second big challenge.

"As a leading and experienced supplier, we are expected to provide the total solution," says Qian.

"This means not just the physical hardware components, like the compressor, but also the entire system design, system integration tests in our lab, etc; sort of a combined service package. As we have limited resources, this is also a challenge."

Huayi's experiences are similar. "At this moment, small OEMs in particular don't want to invest too much in changing their production lines and technology," says Zhu.

"They want to monitor and watch the market. If they see that their customers say, 'no, I don't want R134a, I want R290', then they will have no choice. They must change," Zhu explains.

"We want to put some effort into guiding them towards R290."

Nidec Global Appliance Germany, formerly Secop, identifies the government as a key player in triggering greater hydrocarbon uptake in China.

"The Chinese government encourages natural refrigerant usage in China, and has increased the energy efficiency standards of the light commercial market," says Pieter Boink, head of business development and marketing at Nidec Global Appliance Germany. "This will be carried out from June 2018. It will push natural refrigerant usage in China."

GETTING THERE

European OEMs are also hoping to change the market.

AHT Cooling Systems GmbH, an Austrian manufacturer of cabinets operating in China under AHT Cooling Systems Changshu Co. Ltd., is marketing natural refrigerants strongly. "AHT is working on some major projects in China," says Ulrich Bartoleit, head of corporate communications and marketing at AHT. "We see a big interest in replacing old units in the market with AHT's new R290 cabinets."

The cabinet manufacturer has received positive feedback from other customers about this technology.

"Very low energy consumption and stronger cooling performance," Bartoleit says. "And, especially with AHT's plug-in technology, hydrocarbons and

plugins are the perfect match. The customers benefit from having a sustainable system with longer reliability and less lifecycle costs, straight from the initial investment."

Going forward, Embraco's first priority is to educate the market and end users on the importance of considering total cost of ownership, through partnerships with big OEMs and promotion of new hydrocarbon-based light commercial solutions.

The company last year partnered with Chinese multinational Haier, one of the largest white goods suppliers in the world. "We are proud to launch [a bottle cooler] with R290 with Haier. It's really important for the Chinese market," said Herlon Eckermann da Silva, sales account manager for the Asia-Pacific region at Embraco, at China Refrigeration in 2017.

"In China, for most of the market, everything is based on cost," Qian explains.

"The big advantage offered by natural refrigerants is the energy savings. That's why we are introducing this Plug n' Cool concept to help raise the awareness of total cost of ownership with end users."

Nidec is also seeking to make greater inroads into the Chinese market. Last September, it organised a roadshow on natural refrigerant technology.

The fourth annual Nidec/Secop Technology Roadshow saw the company share its experiences with cabinets, vending machines and bottle coolers that use R290 in three different Chinese cities: Qingdao (18 Sept.), Shanghai (20 Sept.) and Shunde (22 Sept.).

"Almost 150 audience members attended these roadshows [and] we shared the content about R290 compressor alternative solutions, NLE, DLE, SCE compressor technical data, a low-temperature cabinet solution, R290 safety, etc.," says Boink.

The company is also helping big end users move HFC fridges to hydrocarbons in China. "We are involved in many of the projects driven by the big end user groups," he says.

"A clear example of this is the initiative *Refrigerants Naturally!* which is driven by the Coca-Cola Company, PepsiCo, Red Bull and Unilever, and supported by Greenpeace and UN Environment," he adds.

With these manufacturers' help, the journey towards hydrocarbon-based HVAC&R technology – which began with a man called Wolo back in the 1990s – is set to further transform the commercial refrigeration sector in China into an energy-efficient, lucrative and climate-friendly business. ■ CM & DY

1 / Embraco Plug n' Cool unit

2 / AHT's new Vento Green refrigerated shelf at EuroShop 2017



1 /

2 /



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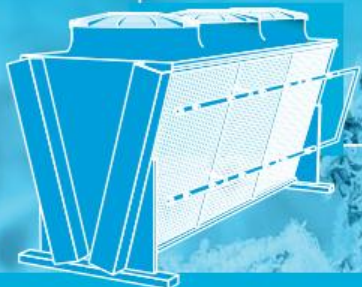


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PREPARING FOR MORE CO₂ IN CHINA FOOD RETAIL



Following the installation of the Chinese retail sector's first transcritical CO₂ system in January this year, leading domestic contractors and overseas suppliers are calling for more training and more local availability of components for a CO₂ food retail market that is ripe for growth.

– By Devin Yoshimoto

The installation of China's first transcritical CO₂ system in the retail sector, in a METRO wholesale store in Beijing ([see cover story on page 22](#)), is triggering wider interest in CO₂ technology for food retail in the country.

Yet with this growing awareness comes the realisation among leading Chinese contractors and suppliers that a number of challenges must be addressed if the CO₂ food retail market is to fulfill its potential.

Local availability of training and components are two of the biggest. Addressing these and other challenges can help the market for CO₂ systems in Chinese retail to flourish.

UPSKILLING CHINA'S TECHNICIANS

Shanghai Fute Refrigeration & Electrical Engineering Co., Ltd. (Fute) is one of China's leading contractors. Its long history of working with CO₂ solutions dates back to 2010, when it served as the main contractor for the design and installation of China's first subcritical CO₂ cascade system at a Tesco store in Shanghai.

More recently, the company served as the lead contractor for METRO China's first transcritical CO₂ installation, commissioned in December 2017.

Through the years, Fute has gained valuable knowledge and expertise with CO₂. It has also identified training as key to continuing the push for CO₂ systems in China going forward.

"There is a skill shortage in China in the field of CO₂ technology," says David Zhang, general manager for Fute.

"There are limited teams who are capable of carrying out the various tasks involved including system design, equipment selection, commissioning, service and maintenance."

Zhang argues that awareness of CO₂ systems is generally much higher than six years ago. However, he concedes that there is much room for improvement in terms of training local talent.

"Education is critical, as there is even a pervasive lack of awareness and technical know-how among young engineers and technicians in China," he says.

"This is largely due to the fact that they are made to quickly learn the intricacies of a new technology."

Fute, for its part, has been actively training its own staff of technicians since 2012, in preparation for what it sees as growing demand for this technology.

"We established an in-house pilot training programme in 2012 for all of our technicians that covers basic technical training," says Zhang.

In addition, Fute places an emphasis on on-site training, which Zhang believes is the most valuable type of training for its technicians.

"Because the company has already successfully completed numerous CO₂ projects, on-site training is particularly effective as junior members of the team can watch and learn the often highly bespoke skills required when handling CO₂ systems from more experienced staff," Zhang explains.

The know-how Fute receives from overseas suppliers forms the basis of this training.

"The company facilitates training through the knowledge and insight of its foreign peers abroad who are also experienced in commissioning CO₂ refrigeration systems," says Zhang.

One of these overseas partners is CAREL, which is a long-time partner of Fute in China and has worked on several CO₂ projects in the country.

"What really impacts the uptake of CO₂ is the high level of technical skills required for this technology," says Eason Cheng, Asia Pacific marketing manager for CAREL.

The company is actively working to upskill the industry as well.

"For several years now, CAREL has been organising training for customers and partners, and is cooperating with several local associations," says Cheng.

"CAREL also has a WeChat public account offering different classes on introducing CO₂ technology for subcritical and transcritical systems," he adds.

"These technical articles are becoming very popular, receiving an average of 700 views each."

INCREASING LOCAL SUPPLY

In addition to the need for upskilling, Zhang explains that a lack of locally available technology components in China is also a barrier.

"Many of the production lines for CO₂ components are yet to be introduced to China," says Zhang.

"Equipment and parts suitable for use with CO₂ technology need to be imported as none are available locally. As a result, many contractors and engineering companies do not have access to the right channels to obtain the necessary components," he adds.

"The importation process adds to lead times, which are in many cases quite lengthy, and costly."

Progress on this front, however, is being made by Chinese suppliers such as Shanghai General Fushi Refrigeration Equipment.

The company has taken the lead investing in the research and development of CO₂ showcases and cabinets early on, making access to these components easier in the local Chinese market.

"We started with CO₂ projects in 2014," says Tingxun Zhang [Tingxun], (former) general manager for Shanghai General Fushi Refrigeration Equipment.

The decision at that time, Tingxun explains, was driven by the boom in CO₂ adoption observed in Europe.

"Large international manufacturers and suppliers need to support the CO₂ market by introducing more CO₂ technology and production to China."

- David Zhang, general manager, Fute

Ever since, the company has been a key local supplier of CO₂ showcases and is now strengthening its ability to supply and manufacture CO₂ components in China.

"We have done a lot of research and development in our factory and test facility with subcritical CO₂," says Tingxun.

"For us, I think our next steps are doing more subcritical CO₂ projects for the local Chinese supermarkets and foreign brand supermarkets. At the same time, we will continue to prepare for [more] transcritical CO₂ systems in our factory – definitely," Tingxun says.

Despite the challenges, suppliers remain confident that the opportunities in this sector will not be lost among the rest of the industry.

"Large international manufacturers and suppliers need to support the CO₂ market by introducing more CO₂ technology and production to China," says Zhang.

"I would advise system and component suppliers and manufacturers who are interested in the CO₂ market to vigorously pursue this field. As confidence in this field increases, there is likely to be significant growth and investment opportunities in the future."

"People need to understand that low returns today do not necessarily mean low returns tomorrow."

■ DY



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DRIVING CHANGE IN CHINA

Danfoss is working on the ground in China to help speed up uptake of natural refrigerants. Accelerate China reports.

– By Devin Yoshimoto



“We showed a very clear trend in this industry to our peers.”

- Jackie Xiao, Danfoss China

For close to a decade, Danfoss has been actively working to educate the Chinese market on natural refrigerant technology.

With its deep knowledge and experience gained from supplying refrigeration components in different regions around the world, the company has sought to share knowledge gained and hold a dialogue with the HVAC&R industry in China.

Through this experience, Danfoss China has witnessed and played a key role in the country's increasingly accelerating transition away from f-gas use in all sectors of the HVAC&R industry.

Accelerate China spoke with key members of the Danfoss China team to learn more about its work to promote natural refrigerants in the country.

A CLEAR TREND

For Danfoss China, efforts to begin spreading education and awareness about natural-refrigerant technologies began several years ago in China's industrial refrigeration sector.

"Around seven years ago, Danfoss organised the first and second 'CO₂ Roadshows' for the industrial refrigeration sector in China," says Jackie Xiao, senior marketing communications manager for Danfoss Cooling Segment China.

"[The CO₂ Roadshow] covered around 20 cities and 2,000+ industrial stakeholders. We invited European experts to come to China and share their experience

with CO₂ applications for industrial refrigeration. We showed a very clear trend in this industry to our peers."

The roadshow was well received, Xiao explains, among the technical personnel and facility managers who showed a clear interest in the latest technology being used in the industry.

"At that time there were zero CO₂ projects in China's industrial refrigeration sector," says Xiao.

A series of accidents involving ammonia refrigeration systems at cold storage facilities in China during this time also piqued interest in CO₂.

"CO₂ systems attracted even more interest after these events as the gas is non-toxic and non-flammable," says Alfred Huang, application and business development manager at Danfoss China (industrial refrigeration).

What resulted was a significant growth in the number of installations of CO₂-based systems in industrial refrigeration facilities.

"In the industrial refrigeration sector in China, we have already supplied CO₂ components for more than 100 projects in the past three to four years," says Huang.

All of the CO₂ projects for industrial refrigeration that Danfoss supplied used either cascade CO₂ systems (using a combination of CO₂ and f-gases) or pumped CO₂ brine systems.



“In 2017 we've witnessed another major uptick in sales of CO₂ components for Danfoss”

- Torben Funder-Kristensen, Danfoss

However, Danfoss sees this trend continuing today as the level of CO₂ technology advances.

"People are starting to think about using transcritical CO₂ systems for industrial refrigeration in China as well," says Alfred.

For the industrial refrigerant market in China, new technology options such as low-charge ammonia or transcritical CO₂ systems offer businesses the opportunity to both increase the safety and energy efficiency of their operations as China continues to move away from the use of f-gases going forward.

SPREADING AWARENESS AND EDUCATION

Danfoss China is keen to replicate its industrial refrigeration success by helping natural refrigerants to secure a bigger share of the food retail market in the coming years.

The food retail sector, however, comes with a whole new set of challenges, as the team has learned over the past year.

Its first CO₂ Roadshow dedicated to China's food retail sector was completed last year in February.

"Experts from Europe and Asia participated in three seminars in Beijing, Shanghai and Guangzhou and covered around 300 food retail industry stakeholders," says Xiao.

"We shared the latest updates on regulations and the current status of state-of-the-art CO₂ technologies from around the world to our China peers," Xiao says.

Though the reception was positive, engagement with the attendees revealed much more work needed to be done to educate this sector.

"We have talked with some of the local retailers last year after the roadshow, and they showed interest in CO₂," says Arthur Pei, marketing manager of Danfoss China food retail.

"But later when we checked again, they said CO₂'s high operating pressure has been a big concern with the government -- especially in supermarkets and hypermarkets where a lot of customers are present. So, they would be very strict to approve any CO₂ project, particularly in big cities like Beijing and Shanghai."

For now, Danfoss will continue to work to inform all of the stakeholders in the market, in cooperation with several other key market players to change this situation.

"We still have some work to do to increase market awareness and education with these customers – to show them natural-refrigerant systems and the benefits they can achieve both environmentally and economically."

Demonstrating global trends are also key to educating the market, Arthur says.

"CO₂ is quite normal in Europe. In the United States, it is also coming. There is no safety issue or risk in that," says Pei.

"In our neighbourhood, in Japan, there are thousands of successful cases of using CO₂ solutions for food retail," adds Xiao.

"But in China, there is less than one hundred. It is very small. So that's why there is very big potential here."

For Danfoss, globally, the direction is clear. Natural refrigerant component sales continue to grow for the company.

"In 2017 we've witnessed another major uptick in sales of CO₂ components for Danfoss," says Danfoss' head of public and industry affairs, Torben Funder-Kristensen.

"In fact, the growth rate was the largest seen since the launch of the first dedicated controls for transcritical CO₂ systems by Danfoss more than 10 years ago."

The level of technology continues to accelerate and costs are continuing to go down.

"In 2018, Danfoss expects the positive trend from 2017 to continue," says Funder-Kristensen.

"CO₂, especially, will see high growth, where we expect to see increasing interest in industrial, food retail, and a variety of commercial refrigeration applications."

Danfoss China is certainly laying the foundations for success with natural refrigerants in China in the coming years. ■ DY

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HONG FU THE FIRST HOMEGROWN RETAILER TO OPT FOR CO₂

Last year, Hong Fu Supermarkets became China's first homegrown retailer to install a CO₂ cascade system, signalling a key milestone in showcasing natural refrigerants on the local Chinese market.

– By Devin Yoshimoto

In September 2017 Chinese retailer Hong Fu Supermarkets celebrated the grand opening of its completely renovated 'Homeful' brand flagship store in Hefei, Anhui province, in eastern China.

The renovation included retrofitting the refrigeration system, replacing the store's R22 circuit with a subcritical CO₂ cascade solution – the first of its kind to be done by a locally owned Chinese supermarket chain.

While international retail brands continue to lead the uptake of natural refrigerants in China, it is local retailers who hold the key to furthering the business case for natural refrigerants in the country. Awareness-raising and education are essential in this regard.

LOCAL APPLICATION, INTERNATIONAL RECOGNITION

Initial project planning began more than a year prior to the Hefei store's grand opening.

In May 2016, US multinational Emerson, in cooperation with local Chinese OEMs and contractors, began leading the preliminary design phase of the project.

Then in September 2016, the Chinese Ministry of Environmental Protection's Foreign Economic Cooperation Office (MEP-FECO), together with the United Nations Development Programme (UNDP), held an International Ozone Day celebration in Beijing.

Low-temperature CO₂ rack

On this occasion, an official 'Letter of Intent' was signed by Hong Fu Supermarkets to install the subcritical CO₂ cascade refrigeration system as a demonstration project supported by UNDP and MEP-FECO.

Hong Fu Supermarkets wanted to demonstrate its leadership in environmental awareness and energy efficiency through this demonstration project.

With the CO₂ refrigeration system, the company expected to achieve significant energy savings benefits, higher refrigerated product quality, and a large reduction in carbon emissions.

Hong Fu also aimed to help raise awareness of the need to adopt new environmentally friendly and energy-efficient refrigeration technology.

This recognition was made public in November 2017, after the installation was completed and the store was opened, in a press conference at which Hong Fu Supermarkets was jointly awarded the title 'CO₂ Refrigeration Demonstration Supermarket' by UNDP and MEP-FECO.

"We hope that through our practical actions, we will drive the entire industry to focus on new technologies, care for the environment and reduce carbon emissions," the company said in a statement.

ENERGY SAVINGS, INCREASING AWARENESS

Local and international technology suppliers have all played key roles in this project.

US-based Emerson, a global leader in supplying CO₂ technology, helped facilitate the system design together with local OEMs and contractors. This process was complemented by discussions between Hong Fu Supermarkets, the UN and MEP-FECO.

Domestic manufacturer Cryotek supplied the rack. Overseas suppliers including Emerson, Danfoss and ESK Schultze supplied other key components.

Challenges encountered during the system commissioning process represented opportunities to train local technicians on how to use the technology.

"The main challenge was to keep the CO₂ system working in a stable condition, as the pressure level of CO₂ is quite high," says Younker You of Emerson.

By using Emerson's digital technology on both the CO₂ and R134a compressors, the Emerson team was able to "keep the system pressure very stable, which resulted in stable showcase temperatures and significant energy savings".

In addition, the company aims to provide training resources for the technicians of its local Chinese partners.

PROJECT TIMELINE:

- ▶ **May/June 2016:** Preliminary design passes FECO assessment.
- ▶ **Sept. 2016:** Hong Fu Supermarkets signs 'Letter of Intent' with MEP-FECO.
- ▶ **Dec. 2016:** System design optimised.
- ▶ **March 2017:** System design finalised. Hong Fu Supermarkets selects equipment.
- ▶ **April 2017:** Installation begins.
- ▶ **July 2017:** Installation completed, system commissioned.
- ▶ **Sept. 2017:** Store grand opening.
- ▶ **Nov. 2017:** Hong Fu Supermarkets awarded title of 'CO₂ Refrigeration Demonstration Supermarket' by UNDP and MEP-FECO.



Refrigerated cabinets

"Emerson would like to share our CO₂ technology and experience with the market," says You.

"We would like to take the opportunity of the Suzhou training centre to educate more and more skilled technicians in natural refrigerant technology."

While data collection is ongoing, current estimates place energy savings at 13% and a 10.8% reduction in TEWI (Total Equivalent Warming Impact) compared to the previous R22 system.

Going forward, Emerson sees this first store as an important milestone in terms of the local Chinese market's interest in natural refrigerants.

"Actually, we have been getting more and more inquiries from local retailers about the CO₂ systems," says You.

Regarding the challenges for the local Chinese market, You admits that technician skill levels and system costs still need to be addressed.

"Good technicians who have a solid knowledge of CO₂ and who are well trained are necessary," says You.

In addition, You believes financial support will continue to be needed for local retailers to consider replacing their f gas-based systems with natural refrigerant-based alternatives.

"New technologies such as digital modulation, electronic expansion valves and advanced controls will help overcome the financial pressure through improving system efficiency, but this still requires the retailer to consider the investment payback time," says You.

"If the government could provide more financial support and industry associations such as CCFA (Chinese Chain Store and Franchise Association) could organise more promotional activities to showcase the Hong Fu Supermarkets project and CO₂ solutions, it would help the Chinese market to understand natural refrigerant technology and accelerate its growth." ■ DY

Freezer showcases, Homeful store, Hefei



HONG FU SUPERMARKETS:

CO₂ CASCADE SYSTEM SPECIFICATIONS

- ▶ Address: Suzhou Road Central Plaza, Hefei, Anhui province, China
- ▶ Store size: 5,700m²
- ▶ Fresh produce sales area: 1,500m²
- ▶ Medium Temperature (MT)
 - ▶ 25 HP Emerson Stream R134a compressors: 4 (one with digital modulation)
 - ▶ Evaporating temperature: -10°C
 - ▶ Cooling capacity: 85.6 kW
 - ▶ MT showcases: 20
 - ▶ MT cold room: 1
- ▶ Low Temperature (LT)
 - ▶ Z034 Emerson Copeland CO₂ Scroll compressors: 3 (one with digital modulation)
 - ▶ Evaporating temperature: -35°C
 - ▶ Cooling capacity: 16.1 kW
 - ▶ LT showcases: 13
 - ▶ LT cold room: 1

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PAPRSDL showroom

CO₂'S BRIGHT FUTURE IN CHINA

Panasonic's China-based factory has begun shifting production towards CO₂ refrigeration systems, in response to energy efficiency and environmental sustainability trends in China and around the world.

– By Devin Yoshimoto, Jan Dusek, Yingwei Tao & Rena Okabe

In July 2016, Panasonic established Panasonic Appliances Refrigeration System (Dalian) Co., Ltd. (PAPRSDL), a joint venture between Japan's Panasonic Corporation and China's Bingshan Group, one of the country's largest manufacturers of refrigeration and air-conditioning equipment.

The goal, according to the press release, was to “bolster the food distribution and low-temperature distribution businesses” in China.

The move was telling. 2017 saw China's biggest retailers make large investments in cold chain logistics and food distribution.

Last December, for example, e-commerce giant Alibaba announced plans to open 2,000 new stores in China over

the next five years as a part of its “new retail” strategy – focused on fresh food delivery and heavily reliant on cold chain logistics.

This retail trend goes hand-in-hand with the desire of these companies to invest in infrastructure that is energy efficient and environmentally sustainable. It is in this context that PAPRSDL is witnessing growing demand for environmentally friendly and energy-efficient CO₂ refrigeration systems.

This demand increase has driven the company to continue investing in CO₂ technology in anticipation of further growth in this sector in the coming years.

Accelerate China visits the PAPRSDL factory, in the Chinese port city of Dalian, to find out how this transition is taking place.



Panasonic subcritical CO₂ rack

Subcritical CO₂ systems on the rise in China

For several years now, Panasonic's Dalian factory has been supplying subcritical CO₂ cascade systems to the Chinese market.

"I think in the past three years or so, cascade systems have become very popular in China," says PAPRSDL's overseas sales director, Li Li Du.

"Many end users we see now need CO₂ cascade."

Driving this growth, Du explains, is increased customer awareness of the environmental benefits of CO₂ cascade systems.

"In the Chinese market, a number of the customers who are moving away from R22 or R404A are converting to CO₂ cascade systems due to the environmental benefits," says Du.

"With CO₂ cascade systems, the Freon [gas] is only in the machine room and the charge is smaller."

Asked whether the trend would continue, Du confidently replies:

"Yes, [the number of] subcritical CO₂ cascade systems will increase."

Through these installations, Du and her team of Chinese engineers at PAPRSDL have built up an impressive level of technological expertise. "We have very good CO₂ cascade technology," said Du.

"We also have a project management team and an R&D team."

This expertise has led them to install larger scale systems for industrial end users – an application of subcritical CO₂ cascade that is not yet widely seen in the industry.

On display on a placard next to their subcritical CO₂ cascade system in the factory showroom is a description of the company's installation of a subcritical CO₂ cascade system for HNA Sinosun Logistics – part of large Chinese conglomerate HNA Group, which focuses on tourism, aviation, and logistics.

The installation was made in an HNA Sinosun Logistics cold storage facility in Beijing.

"The high-temperature system uses a screw compressor with R134a and the low-temperature system uses CO₂," says Du.

"The system is very big," she adds.

The installation, subsidised by the Chinese government, signals the support that end users are now receiving to move towards environmentally friendly HVAC&R technology.

Having developed this expertise, the company is now turning its attention to providing more advanced transcritical CO₂ systems for China's industrial sector.

Transcritical on the horizon

In anticipation of growing demand in China and overseas, the company is well positioned and sees transcritical CO₂ technology as the next step.

"We define CO₂ technology in three stages," said Du.

"The first stage is CO₂ used as the secondary refrigerant. The second



stage is CO₂ cascade. The third stage – and what we think is the top stage – is CO₂ transcritical technology.”

As a first step, PAPRSDL will be taking advantage of Panasonic Japan’s market-leading expertise in transcritical CO₂ technology.

To date, Panasonic Japan has installed 8,500 outdoor transcritical CO₂ condensing units worldwide and aims to install another 2,500 globally this fiscal year.

To begin expanding PAPRSDL’s CO₂ product lineup in China, the company will begin manufacturing these units at the factory in Dalian.

“This year we will import the production of Panasonic’s 2 HP and 10 HP CO₂ outdoor condensing units into our factory and begin building them for the Chinese market,” says Du.

The company has also set its sights on eventually building larger transcritical CO₂ systems, for which they see opportunities in the local Chinese market as well as overseas.

“I think [Panasonic’s outdoor condensing] unit is popular in the Japanese market because in Japan there are so many convenience stores equipped with this system,” says Du.

“But in China, the convenience store market is not developed very well. And the Chinese market requires very big sizes. So the customers want to use the central rack units.”

Asked whether the manufacturing of larger transcritical CO₂ rack systems is something they are considering, Du replies: “Yes, we want to.”

PAPRSDL’s independence with respect to transcritical CO₂ system development is supported by Panasonic Japan, which sees this

“My goal is to transfer the business and R&D activities for transcritical CO₂ rack systems to Dalian.”

– Shigeru Dohno, managing director of Panasonic Appliance Japan’s food retail business

as a competitive advantage and a key part of the company’s overall strategy.

“People in China are very positive and aggressive, so we are not looking to simply hand over Japanese technology – we’d like the local team to take ownership of the development process themselves,” says Shigeru Dohno, managing director of Panasonic Appliance Japan’s food retail business.

“My goal is to transfer the business and R&D activities for transcritical CO₂ rack systems to Dalian.”

As local Chinese engineers at PAPRSDL begin to manufacture advanced CO₂ systems for the Chinese market, they are optimistic that the time is ripe for more end users to adopt CO₂ in China.

Confident and passionate about their work, Li Li Du and her team are now building the foundations of a bright future for CO₂ in China.

Asked how she sees the future refrigeration market in China, Du replies: “I believe transcritical CO₂ is the future solution. I really believe that.” ■ DY, JD, YT & RO

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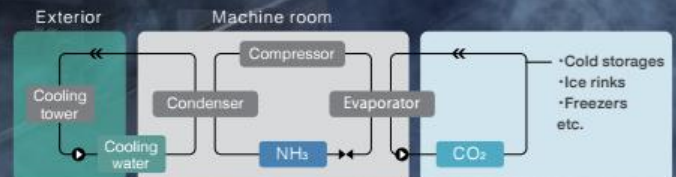
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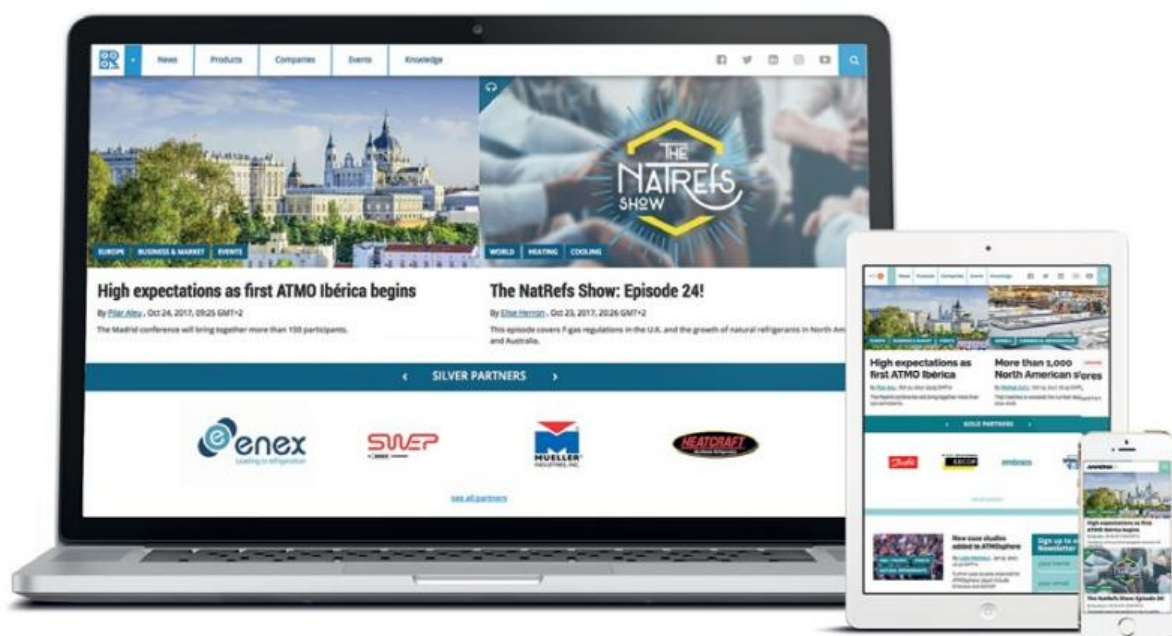
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